Week: 4

1. Write a Java program to implement the concept of inheritance.Code:

```
class Animal {
  String name;
  public Animal(String
     name) {this.name =
     name;
  }
  public void eat() {
     System.out.println(name + " is
     eating.");
  }
}
class Dog extends
  Animal {public
  Dog(String name) {
     super(name);
  }
  public void bark() {
     System.out.println(name + " is
     barking.");
  }
}
class Cat extends
  Animal {public
  Cat(String name) {
     super(name);
  }
  public void meow() {
     System.out.println(name + " is
     meowing.");
  }
}
public class InheritanceExample {
  public static void main(String[]
  args) {
     Dog myDog = new
     Dog("Buddy"); Cat myCat =
     new Cat("Whiskers");
     myDog.eat();
     myCat.eat();
     myDog.bark();
     myCat.meow();
  }
}
```

```
Buddy is eating.
Whiskers is eating.
Buddy is barking.
Whiskers is meowing.
PS D:\RN_1\Coding\JAVA\Assignments\src>
```

2. Write a Java program to show method overloading.

Code:

```
public class MethodOverloadingExample {
   public int add(int a, int
```

```
    b) {return a + b;
  }
  public int add(int a, int b, int
    c) {return a + b + c;
  }
  public double add(double a, double
    b) {return a + b;
  }
  public String concatenate(String str1, String
    str2) {return str1 + str2;
  }
  public static void main(String[] args) {
    MethodOverloadingExample example = new
    MethodOverloadingExample();
    System.out.println("Sum (int): " + example.add(7, 13));
    System.out.println("Sum (int): " + example.add(5, 10, 15));
    System.out.println("Sum (double): " + example.add(3.5, 2.5));
    System.out.println("Concatenation: " + example.concatenate("Hello, ", "world!"));
  }
  }
```

```
Sum (int): 20
Sum (int): 30
Sum (double): 6.0
Concatenation: Hello, world!
PS C:\Users\User\Desktop\Java\practice>
```

3. Write a Java program to show method overriding.Code:

```
class Animal {
 public void sound() {
    System.out.println("Animal makes a
    sound");
 }
}
class Dog extends
 Animal {public void
 sound() {
    System.out.println("Dog barks");
 }
}
public class
 MethodOverridingExample {public
 static void main(String[] args) {
    Animal animal = new
    Animal();Dog dog = new
    Dog(); animal.sound();
    dog.sound();
 }
```

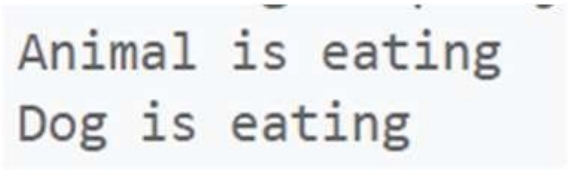
```
}
```

4. Write a Java program to show method hiding.Code:

```
class Animal {
   public static void eat() {
      System.out.println("Animal is
      eating");
   }
}

class Dog extends
   Animal {public static
   void eat() {
      System.out.println("Dog is eating");
   }
}

public class MethodHidingExample {
   public static void main(String[]
   args) {
      Animal.eat();
      Dog.eat();
   }
}
```



5.

Create a general class ThreeDObject and derive the classes Box, Cube, Cylinder and Conefrom it. The class ThreeDObject has methods wholeSurfaceArea ( ) and volume ( ). Override these two methods in each of the derived classes to calculate the volume and whole surfacearea of each type of three-dimensional objects. The dimensions of the objects are to be taken from the users and passed through the respective constructors of each derived class. Write a main method to test these classes.

Code:

```
import
java.util.Scanner;class
ThreeDObject {
   public double
      wholeSurfaceArea() {return
      0.0;
   }
   public double
      volume() {return
      0.0;
   }
}
```

```
class Box extends
   ThreeDObject {private
   double length;
   private double width;
   private double height;
   public Box(double length, double width, double
      height) {this.length = length;
      this.width = width;
      this.height = height;
   }
   public double wholeSurfaceArea() {
      return 2 * (length * width + width * height + height * length);
   }
   public double volume() {
      return length * width * height;
   }
}
class Cube extends
   ThreeDObject {private double
   side;
   public Cube(double
      side) {this.side = side;
   }
   public double
      wholeSurfaceArea() {return 6
      * side * side;
   }
   public double volume() {
      return side * side *
      side;
   }
}
class Cylinder extends
   ThreeDObject {private double
   radius;
   private double height;
   public Cylinder(double radius, double
      height) {this.radius = radius;
      this.height = height;
   }
   public double wholeSurfaceArea() {
      return 2 * Math.PI * radius * (radius + height);
   }
   public double volume() {
      return Math.PI * radius * radius * height;
   }
}
class Cone extends
   ThreeDObject {private double
   radius;
   private double height;
   public Cone(double radius, double
      height) {this.radius = radius;
      this.height = height;
```

```
    }
    public double wholeSurfaceArea() {
        return Math.PI * radius * (radius + Math.sqrt(radius * radius + height * height));
    }
    public double volume() {
        return (Math.PI * radius * radius * height) / 3.0;
    }
}
public class  TestThreeDObjects {
    public static void main(String[]
    args) {
        Scanner scanner = new
        Scanner(System.in);
        System.out.println("Enter dimensions for
        Box:");System.out.print("Length: ");
        double boxLength =
        scanner.nextDouble();
        System.out.print("Width: ");
        double boxWidth =
        scanner.nextDouble();
        System.out.print("Height: ");
        double boxHeight = scanner.nextDouble();
        Box box = new Box(boxLength, boxWidth,
        boxHeight);System.out.println("\nEnter
        dimensions for Cube:"); System.out.print("Side:
        ");
        double cubeSide =
        scanner.nextDouble();Cube cube =
        new Cube(cubeSide);
        System.out.println("\nEnter dimensions for
        Cylinder:");System.out.print("Radius: ");
        double cylinderRadius =
        scanner.nextDouble();
        System.out.print("Height: ");
        double cylinderHeight = scanner.nextDouble();
        Cylinder cylinder = new Cylinder(cylinderRadius,
        cylinderHeight);System.out.println("\nEnter dimensions for
        Cone:"); System.out.print("Radius: ");
        double coneRadius =
        scanner.nextDouble();
        System.out.print("Height: ");
        double coneHeight = scanner.nextDouble();
        Cone cone = new Cone(coneRadius,
        coneHeight);System.out.println("\nResults:");
        System.out.println("Box Surface Area: " + box.wholeSurfaceArea());
        System.out.println("Box Volume: " + box.volume());
        System.out.println("\nCube Surface Area: " +
        cube.wholeSurfaceArea()); System.out.println("Cube Volume: " +
        cube.volume()); System.out.println("\nCylinder Surface Area: " +
        cylinder.wholeSurfaceArea());System.out.println("Cylinder Volume: " +
        cylinder.volume()); System.out.println("\nCone Surface Area: " +
        cone.wholeSurfaceArea()); System.out.println("Cone Volume: " +
        cone.volume());
        scanner.close();
```

```
  }
}
```

```
Length: 10
Width: 20
Height: 30

Enter dimensions for Cube:
Side: 40

Enter dimensions for Cylinder:
Radius: 50
Height: 60

Enter dimensions for Cone:
Radius: 70
Height: 20

Results:
Box Surface Area: 2200.0
Box Volume: 6000.0

Cube Surface Area: 9600.0
Cube Volume: 64000.0
```

6. Write a program to create a class named Vehicle having protected instance variables regnNumber, speed, color, ownerName and a method showData ( ) to show "This is a vehicleclass". Inherit the Vehicle class into subclasses named Bus and Car having individual private instance variables routeNumber in Bus and manufacturerName in Car and both of them having showData ( ) method showing all details of Bus and Car respectively with content of the super class's showData ( ) method.

Code:

```
public class TestVehicle {
}
class Vehicle {
  protected String
  regnNumber;protected int
  speed; protected String
  color; protected String
  ownerName;
  public Vehicle(String regnNumber, int speed, String color, String
     ownerName) {this.regnNumber = regnNumber;
     this.speed =
     speed;this.color =
     color;
     this.ownerName = ownerName;
  }
  public void showData() {
     System.out.println("This is a vehicle
     class");
     System.out.println("Registration Number: " +
     regnNumber);System.out.println("Speed: " + speed);
     System.out.println("Color: " + color);
     System.out.println("Owner Name: " + ownerName);
  }
}
class Bus extends Vehicle
  { private String
  routeNumber;
```

```
  public Bus(String regnNumber, int speed, String color, String ownerName, String
     routeNumber) {super(regnNumber, speed, color, ownerName);
     this.routeNumber = routeNumber;
  }
  public void showData() {
     super.showData();
     System.out.println("This is a
     Bus");
     System.out.println("Route Number: " + routeNumber);
  }
}
class Car extends Vehicle {
  private String manufacturerName;
  public Car(String regnNumber, int speed, String color, String ownerName,
StringmanufacturerName) {
     super(regnNumber, speed, color,
     ownerName);this.manufacturerName =
     manufacturerName;
  }
  public void showData() {
     super.showData();
     System.out.println("This is a
     Car");
     System.out.println("Manufacturer Name: " + manufacturerName);
  }
}
public class Test {
  public static void main(String[] args) {
     Bus myBus = new Bus("123", 60, "Blue", "John Doe",
     "Route 1");Car myCar = new Car("456", 80, "Red", "Jane
     Doe", "Toyota"); System.out.println("Details of Bus:");
     myBus.showData();
     System.out.println("\nDetails of
     Car:");myCar.showData();
  }
}
```

```
Details of Bus:
This is a vehicle class
Registration Number: 123
Speed: 60
Color: Blue
Owner Name: John Doe
This is a Bus
Route Number: Route 1

Details of Car:
This is a vehicle class
Registration Number: 456
Speed: 80
Color: Red
Owner Name: Jane Doe
This is a Car
Manufacturer Name: Toyota
```

7. An educational institution maintains a database of its employees. The database is divided into a number of classes whose hierarchical relationships are shown below. Write all the classes and define the methods to create the database and retrieve individual information asand when needed. Write a driver program to test the classes. Staff (code, name) Officer (grade) is a Staff RegularTypist (remuneration) is a Typist Teacher (subject, publication) is a Staff Typist (speed) is a Staff CasualTypist (daily wages) is a Typist.

Code:
```
class Staff {
   private int code;
   private String
   name;
   public Staff(int code, String
      name) {this.code = code;
      this.name = name;
   }
   public int
      getCode() {
      return code;
   }
   public String
      getName() {return
      name;
   }
}
class Typist extends
   Staff {private int
   speed;

   public Typist(int code, String name, int
      speed) {super(code, name);
      this.speed = speed;
   }
   public int
      getSpeed() {
      return speed;
   }
}
class Officer extends
   Staff {private String
   grade;
   public Officer(int code, String name, String
      grade) {super(code, name);
      this.grade = grade;
   }
   public String
      getGrade() {return
      grade;
   }
}
class RegularTypist extends
   Typist {private double
   remuneration;
```

```
    public RegularTypist(int code, String name, int speed, double
        remuneration) {super(code, name, speed);
        this.remuneration = remuneration;
    }
    public double
        getRemuneration() {return
        remuneration;
    }
}
class Teacher extends
    Staff {private String
    subject; private String
    publication;

    public Teacher(int code, String name, String subject, String
        publication) {super(code, name);
        this.subject = subject;
        this.publication = publication;
    }
    public String
        getSubject() {return
        subject;
    }
    public String
        getPublication() {return
        publication;
    }
}
class CasualTypist extends
    Typist {private double
    dailyWages;
    public CasualTypist(int code, String name, int speed, double
        dailyWages) {super(code, name, speed);
        this.dailyWages = dailyWages;
    }
    public double
        getDailyWages() {return
        dailyWages;
    }
}
public class EducationalInstitution {
    public static void main(String[]
    args) {
        Officer officer = new Officer(101, "John Doe", "Grade A");
        RegularTypist regularTypist = new RegularTypist(201, "Jane Smith", 60, 5000.0);
        Teacher teacher = new Teacher(301, "Alice Johnson", "Math", "Research in
        Education");CasualTypist casualTypist = new CasualTypist(401, "Bob Brown",
        50, 100.0);
        System.out.println("Officer Information:");
        System.out.println("Code: " + officer.getCode());
        System.out.println("Name: " + officer.getName());
        System.out.println("Grade: " + officer.getGrade());
        System.out.println("\nRegular Typist Information:");
        System.out.println("Code: " + regularTypist.getCode());
```

```
        System.out.println("Name: " + regularTypist.getName());
        System.out.println("Speed: " + regularTypist.getSpeed());
        System.out.println("Remuneration: " +
        regularTypist.getRemuneration());System.out.println("\nTeacher
        Information:");
        System.out.println("Code: " + teacher.getCode());
        System.out.println("Name: " + teacher.getName());
        System.out.println("Subject: " + teacher.getSubject());
        System.out.println("Publication: " + teacher.getPublication());
        System.out.println("\nCasual Typist Information:");
        System.out.println("Code: " + casualTypist.getCode());
        System.out.println("Name: " + casualTypist.getName());
        System.out.println("Speed: " + casualTypist.getSpeed());
        System.out.println("Daily Wages: " + casualTypist.getDailyWages());
    }
}
```

```
Officer Information:
Code: 101
Name: John Doe
Grade: Grade A

Regular Typist Information:
Code: 201
Name: Jane Smith
Speed: 60
Remuneration: 5000.0

Teacher Information:
Code: 301
Name: Alice Johnson
Subject: Math
Publication: Research in Education

Casual Typist Information:
Code: 401
Name: Bob Brown
Speed: 50
Daily Wages: 100.0
```

8. Create a base class Building that stores the number of floors of a building, number of rooms and it's total footage. Create a derived class House that inherits Building and alsostores the number of bedrooms and bathrooms. Demonstrate the working of the classes.Code:

```
class Building {
    protected int
    numberOfFloors; protected
    int numberOfRooms;
    protected double
    totalFootage;
    public Building(int numberOfFloors, int numberOfRooms, double
        totalFootage) {this.numberOfFloors = numberOfFloors;
        this.numberOfRooms =
        numberOfRooms;this.totalFootage =
        totalFootage;
    }
    public void displayInfo() {
        System.out.println("Number of Floors: " +
        numberOfFloors); System.out.println("Number of
        Rooms: " + numberOfRooms);System.out.println("Total
        Footage: " + totalFootage + " sq.ft");
    }
}
class House extends Building {
    private int
```

```
    numberOfBedrooms;
    private int numberOfBathrooms;
    public House(int numberOfFloors, int numberOfRooms, double
totalFootage, intnumberOfBedrooms, int numberOfBathrooms) {
        super(numberOfFloors, numberOfRooms,
        totalFootage);this.numberOfBedrooms =
        numberOfBedrooms; this.numberOfBathrooms =
        numberOfBathrooms;
    }
    public void
        displayInfo() {
        super.displayInfo();
        System.out.println("Number of Bedrooms: " + numberOfBedrooms);
        System.out.println("Number of Bathrooms: " + numberOfBathrooms);
    }
}
public class Main {
    public static void main(String[] args) {
        House myHouse = new House(2, 5, 2000.0,
        3, 2);System.out.println("House
        Information:"); myHouse.displayInfo();
    }
```

```
House Information:
Number of Floors: 2
Number of Rooms: 5
Total Footage: 2000.0 sq.ft
Number of Bedrooms: 3
Number of Bathrooms: 2
PS C:\Users\User\Desktop\Java\practice>
```

```
}
```

9. In the earlier program, create a second derived class Office that inherits Building andstores the number of telephones and tables. Now demonstrate the working of all three classes.

Code:

```
class Building {
    protected String
    address;protected int
    floors;
    public Building(String address, int
        floors) {this.address = address;
        this.floors = floors;
    }
    public  void display()  {
        System.out.println("Address: " + address);
        System.out.println("Number of floors: " +
        floors);
    }
}
class Office extends
    Building {private int
    telephones; private int
    tables;
```

```
    public Office(String address, int floors, int telephones, int
       tables) {super(address, floors);
       this.telephones =
       telephones;this.tables =
       tables;
    }
    public void
       display() {
       super.display();
       System.out.println("Number of telephones: " +
       telephones);System.out.println("Number of tables: " +
       tables);
    }
}
class House extends
    Building {private int
    bedrooms; private int
    bathrooms;
    public House(String address, int floors, int bedrooms, int
       bathrooms) {super(address, floors);
       this.bedrooms =
       bedrooms; this.bathrooms
       = bathrooms;
    }
    public void
       display() {
       super.display();
       System.out.println("Number of bedrooms: " + bedrooms);
       System.out.println("Number of bathrooms: " + bathrooms);
    }
}
public class BuildingDemo {
    public static void main(String[] args) {
       Office office = new Office("123 Main St", 5, 20,
       50);House house = new House("456 Elm St",
       2, 3, 2); System.out.println("Office  details:");
       office.display();
       System.out.println("\nHouse
       details:");house.display();
    }}
```

```
Office details:
Address: 123 Main St
Number of floors: 5
Number of telephones: 20
Number of tables: 50

House details:
Address: 456 Elm St
Number of floors: 2
Number of bedrooms: 3
Number of bathrooms: 2
```

10. Write a Java program which creates a base class Num and contains an integer numberalong with a method shownum() which displays the number. Now create a derived class HexNum which inherits Num and overrides shownum() which displays the hexadecimal value of the number. Demonstrate the working of the classes.

Code:
```
class Num {
   protected int number;
   public Num(int
   number) {
      this.number = number;
   }
   public void shownum() {
      System.out.println("Decimal Value: " +
      number);
   }
}
class HexNum extends Num {
   public HexNum(int number) {
      super(number);
   }
   public void shownum() {
      System.out.println("Hexadecimal Value: " + Integer.toHexString(number));
   }
}
public class NumDemo {
   public static void main(String[]
      args) {Num numObj = new
      Num(255);
      System.out.println("Using base class
      Num:");numObj.shownum();
      HexNum hexNumObj = new HexNum(255);
      System.out.println("\nUsing derived class
      HexNum:");hexNumObj.shownum();
   }
}
```

```
Using base class Num:
Decimal Value: 255

Using derived class HexNum:
Hexadecimal Value: ff
```

11. Write a Java program which creates a base class Num and contains an integer number along with a method shownum() which displays the number. Now create a derived class OctNum which inherits Num and overrides shownum() which displays the octal value of thenumber. Demonstrate the working of the classes.

Code:
```
class Num {
   protected int number;
   public Num(int
   number) {
      this.number = number;
   }
   public void showNum() {
      System.out.println("Number: " +
```

```
        number);
    }
}
class OctNum extends Num {
    public OctNum(int number) {
        super(number);
    }
    public void showNum() {
        System.out.println("Octal Value: " + Integer.toOctalString(number));
    }
}
public class Main {
    public static void main(String[]
        args) {Num num = new
        Num(10);
        OctNum octNum = new OctNum(10);
        System.out.println("Num Class:");
        num.showNum();
        System.out.println("\nOctNum Class:");
        octNum.showNum();
    }
}
```

```
Num Class:
Number: 15
PS C:\Users\User\Desktop\Java\practice>
```

12. Combine Question number 10 and 11 and have all the three classes together. Nowdescribe the working of all classes.

Code:

```
class Num
    {int number;
    public Num(int number) {
        this.number = number;
    }
    public void shownum() {
        System.out.println("Decimal: " +
        number);
    }
}
class HexNum extends Num {
    public HexNum(int number) {
        super(number);
    }
    public void shownum() {
        System.out.println("Hexadecimal: " + Integer.toHexString(number));
    }
}
class OctNum extends Num {
    public OctNum(int number) {
        super(number);
    }
    public void shownum() {
        System.out.println("Octal: " + Integer.toOctalString(number));
    }
```

```
}
public class Main {
   public static void main(String[]
      args) {Num num1 = new
      Num(10); num1.shownum();
      HexNum hex_num = new
      HexNum(255);hex_num.shownum();
      OctNum oct_num = new
      OctNum(64);oct_num.shownum();
   }
}
```

```
Decimal: 10
Hexadecimal: ff
Octal: 100
```

13. Create a base class Distance which stores the distance between two locations in miles and a method travelTime(). The method prints the time taken to cover the distance when thespeed is 60 miles per hour. Now in a derived class DistanceMKS, override travelTime() so that it prints the time assuming the distance is in kilometers and the speed is 100 km per second. Demonstrate the working of the classes.

Code:

```
class Distanceprotected double distanceMiles;
   public Distance(double
      distanceMiles) {this.distanceMiles
      = distanceMiles;
   }
   public void travelTime() {
      double speedMilesPerHour = 60.0;
      double timeHours = distanceMiles / speedMilesPerHour;
      System.out.println("Time taken to cover " + distanceMiles + " miles at 60 miles per
hour: " +timeHours + " hours");
   }
}
class DistanceMKS extends Distance {
   public DistanceMKS(double
      distanceMiles) {super(distanceMiles);
   }
   public void travelTime() {
      double speedKilometersPerSecond = 100.0 / 3600.0; // converting speed from km per
secondto km per hour
      double distanceKilometers = distanceMiles * 1.60934; // converting distance from
miles tokilometers
      double timeSeconds = distanceKilometers / speedKilometersPerSecond;
      System.out.println("Time taken to cover " + distanceMiles + " miles at 100 km per
      second: " +
timeSeconds + " seconds");
   }
}
public class DistanceDemo {
   public static void main(String[] args) {
      Distance distanceObj = new
```

```
        Distance(100);
        System.out.println("Using base class
        Distance:");distanceObj.travelTime();
        DistanceMKS distanceMKSObj = new
        DistanceMKS(100); System.out.println("\nUsing
        derived class DistanceMKS:");
        distanceMKSObj.travelTime();
    }
}
```

```
Using base class Distance:
Time taken to cover 100.0 miles at 60 miles per hour: 1.6666666666666667 hours

Using derived class DistanceMKS:
Time taken to cover 100.0 miles at 100 km per second: 5793.624 seconds
```

14. Create a base class called “vehicle” that stores number of wheels and speed. Create thefollowing derived classes – “car” that inherits “vehicle” and also stores number of passengers. “truck” that inherits “vehicle” and also stores the load limit. Write a main function to create objects of these two derived classes and display all the information about“car” and “truck”. Also compare the speed of these two vehicles - car and truck and displaywhich one is faster.

Code:

```
class Vehicle {
    protected int
    numberOfWheels;protected
    int speed;
    public Vehicle(int numberOfWheels, int
        speed) {this.numberOfWheels =
        numberOfWheels; this.speed = speed;

    public int
        getSpeed() {
        return speed;
    public void displayInfo() {
        System.out.println("Number of Wheels: " +
        numberOfWheels);System.out.println("Speed: " + speed
        + " km/h");
    }
}
class Car extends Vehicle {
    private int numberOfPassengers;
    public Car(int numberOfWheels, int speed, int
        numberOfPassengers) {super(numberOfWheels, speed);
        this.numberOfPassengers = numberOfPassengers;
    }
    public void
        displayInfo() {
        super.displayInfo();
        System.out.println("Number of Passengers: " + numberOfPassengers);
    }
}
class Truck extends
    Vehicle {private int
    loadLimit;
    public Truck(int numberOfWheels, int speed, int
        loadLimit) {super(numberOfWheels, speed);
```

```
    this.loadLimit = loadLimit;
  }
  public
```

```
Car Information:
Number of Wheels: 4
Speed: 120 km/h
Number of Passengers: 5

Truck Information:
Number of Wheels: 6
Speed: 80 km/h
Load Limit: 10 tons

Car is faster than Truck.
```

```
    void displayInfo() {
    super.displayInfo();
    System.out.println("Load Limit: " + loadLimit + " tons");
  }
}
public class Main {
  public static void main(String[] args) {
    Car myCar = new Car(4, 120, 5);
    Truck myTruck = new Truck(6, 80,
    10);System.out.println("Car
    Information:"); myCar.displayInfo();
    System.out.println("\nTruck
    Information:");myTruck.displayInfo();
    if (myCar.getSpeed() > myTruck.getSpeed()) {
      System.out.println("\nCar is faster than
      Truck.");
    } else if (myCar.getSpeed() <
      myTruck.getSpeed()) {
      System.out.println("\nTruck is faster than
      Car.");
    } else {
      System.out.println("\nCar and Truck have the same speed.");
    }
  }
```

15. Write a Java program to explain "multilevel inheritance."Code: class Animal {

```
  void eat() {
    System.out.println("Animal is eating.");
  }
}
class Dog extends
  Animal {void bark() {
    System.out.println("Dog is barking.");
  }
  Dog() {
    super();
  }
}
class Bulldog extends
```

```
    Dog {void guard() {
        System.out.println("Bulldog is guarding.");
    }
    Bulldog()
        {
        super()
        ;
    }
}
public class Main {
    public static void main(String[]
        args) {Bulldog myDog = new
        Bulldog(); myDog.eat();
        myDog.bark();
        myDog.guard(
        );
    }
}
```

```
Animal is eating.
Dog is barking.
Bulldog is guarding.
PS C:\Users\User\Desktop\Java\practice>
```