## 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.
3. Code: public class MethodOverloadingExample {
  public int add(int a, int
    b) {return a + b;
  public int add(int a, int b, int
    c) \{\text{return a} + \text{b} + \text{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>
4. 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();
}
```

Animal makes a sound Dog barks

## 5. 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();
Animal is eating
Dog is eating
```

6.

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
```

7. 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
```

8. 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
9. Create a base class Building that stores the number of floors of a building,
```

9. 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>
     In the earlier program, create a second derived class Office that inherits
Building and stores 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
```

11. 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
```

12. 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>
```

13. 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
```

14. 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

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distance when the speed 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 Distance {

```
protected 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
    DistanceMKS(100);
                             System.out.println("\nUsing
    derived
                                        DistanceMKS:");
                       class
    distanceMKSObj.travelTime();
Using base class Distance:
Using derived class DistanceMKS:
Time taken to cover 100.0 miles at 100 km per second: 5793.624 seconds
15. Create a base class called "vehicle" that stores number of wheels and speed.
```

15. 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 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.");
}
```

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.

```
16. 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>
```