

1. **Design a Java program to manage a list of students using a Student class. Each student should have attributes such as name, rollNumber, and marks. Implement constructor overloading by creating multiple constructors to initialize student objects in different ways—using only the name, using name and roll number, and using all three attributes. Use an array of objects to store multiple students and implement methods to calculate the average marks of all students and display the details of all students.**

```
public class Student {  
  
    static final int TOTAL_STUDENTS = 100;  
  
    static Student[] student = new Student[TOTAL_STUDENTS];  
  
    static int numStudents = 0;  
  
  
    String name;  
  
    int rollNum;  
  
    int marks;  
  
  
    Student(String name, int rollNum, int marks){  
  
        this.name = name;  
  
        this.rollNum = rollNum;  
  
        this.marks = marks;  
  
    }  
  
  
    Student(String name){  
  
        this.name = name;  
  
    }  
  
  
    Student(String name, int rollNum){
```

```
    this.name = name;
    this.rollNum = rollNum;
}
```

```
static double calculateAvgMarks(){
    int totalMarks = 0;
    for(int i = 0; i < numStudents; i++){
        totalMarks += student[i].marks;
    }
    double avg = totalMarks / numStudents;
    return avg;
}
```

```
public static void main(String[] args){
    student[numStudents++] = new Student("Studen1", 1, 390);
    student[numStudents++] = new Student("Studen2", 2);
    student[numStudents++] = new Student("Studen3");

    System.out.println("\n---- List of students ----");
    for (int i = 0; i < numStudents; i++) {
        System.out.printf("\nRoll no: %d. Name: %s Marks: %d\n", student[i].rollNum,
student[i].name, student[i].marks);
    }
    calculateAvgMarks();
}
}
```

2. **Design a Java program to calculate the volumes of different 3D shapes (Cylinder, Cuboid, Sphere) using individual classes for each shape. Each class should encapsulate its dimensions as private attributes, use a constructor to initialize them, and include a method to calculate and return the volume. Additionally, use a static member to keep track of the total number of 3D shape objects created.**

```
public class Volume {
    class Shapes3D {
        static int totalShapes = 0;

        Shapes3D(){
            totalShapes++;
        }

        double getVolume(){
            return 0.0;
        }
    }

    // Cuboid class
    class Cuboid extends Shapes3D{
        private double length, width, height;

        Cuboid(double length, double width, double height){
            super();
            this.length = length;
            this.width = width;
            this.height = height;
        }

        double getVolume(){
            return length * width * height;
        }
    }

    // Cylinder class
    class Cylinder extends Shapes3D{
```

```

private double radius, height;

Cylinder(double radius, double height){
    super();
    this.radius = radius;
    this.height = height;
}

double getVolume(){
    return Math.PI * radius * radius * height;
}
}

// Sphere Class
class Sphere extends Shapes3D{
    private double radius;

    Sphere(double radius){
        this.radius = radius;
    }

    double getVolume(){
        return (4.0 / 3.0) * Math.PI * radius * radius * radius;
    }
}

public static void main(String[] args) {
    Volume volume = new Volume();

    Shapes3D cuboid = volume.new Cuboid(10, 20, 30);
    Shapes3D cylinder = volume.new Cylinder(30, 50);
    Shapes3D sphere = volume.new Sphere(30);

    System.out.printf("Cuboid Volume: %.2f\n", cuboid.getVolume());
    System.out.printf("Cylinder Volume: %.2f\n", cylinder.getVolume());
    System.out.printf("Sphere Volume: %.2f\n", sphere.getVolume());

    System.out.println("The total number of shapes is: "+Shapes3D.totalShapes); }

```

3. **Design a Java program to manage a library system using an array of Book objects. Each Book should have attributes like title, author, and price. Implement methods to add books to the library, calculate the total cost of all books, and display the details of all books in the library. This program should demonstrate the use of**

```
import java.util.Scanner;
```

```
public class Library {
```

```
    public static class Book {
```

```
        String title;
```

```
        String author;
```

```
        double price;
```

```
        Book(String title, String author, double price){
```

```
            this.title = title;
```

```
            this.author = author;
```

```
            this.price = price;
```

```
        }
```

```
        void displayDetails(){
```

```
            System.out.println("\nTitle: "+title+", Author: "+author+", Price: ₹"+price);
```

```
        }
```

```
    }
```

```
    static final int MAX_BOOKS = 100;
```

```
    static Book[] library = new Book[MAX_BOOKS];
```

```
    static int bookCount = 0;
```

```
    static void addBook(Scanner scanner){
```

```
        if (bookCount >= MAX_BOOKS) {
```

```
            System.out.println("You cannot any more Books");
```

```
            return;
```

```
        }
```

```
        scanner.nextLine();
```

```
        System.out.println("\nEnter the title of the book: ");
```

```
        String title = scanner.nextLine();
```

```

        System.out.println("\nEnter the name of the author: ");
        String author = scanner.nextLine();

        System.out.println("\nEnter the price of the book: ");
        double price = scanner.nextDouble();

        library[bookCount++] = new Book(title, author, price);
        System.out.println("Book added successfully");
    }

    static void displayAllBooks(){
        if(bookCount == 0){
            System.out.println("\nThe library is empty!");
            return;
        }
        System.out.println("\nList of book in the library: ");
        for(int i = 0; i < bookCount; i++){
            System.out.println("\n" + (i+1) + ". ");
            library[i].displayDetails();
        }
    }

    static void totalBookCost(){
        double total = 0.0;
        for (int i = 0; i < bookCount; i++) {
            total += library[i].price;
        }
        System.out.println("\nThe total cost of the books is: " + total);
    }

    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        int choice;

        while (true) {
            System.out.println("\n\n--- Library Management System ---");
            System.out.println("1. Add Book");
            System.out.println("2. Display All Books");

```

```
System.out.println("3. Total Cost of Books");
System.out.println("4. Exit");
System.out.print("Enter your choice (1-4): ");
choice = sc.nextInt();

switch (choice) {
    case 1:
        addBook(sc);
        break;
    case 2:
        displayAllBooks();
        break;
    case 3:
        totalBookCost();
        break;
    case 4:
        System.out.println("Exiting Program.");
        sc.close();
        return;
    default:
        System.out.println("Invalid choice. Please try again.");
}
}
}
}
```