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Exercise 5b

- Inheritance & Access Modifiers
- Note: Draw Class diagram for each program

1. Create a base class Shape with a protected attribute color and a method getColor() to access it. Then create subclasses like Circle, Rectangle, and Triangle inheriting from Shape and demonstrate access to the protected attribute from the subclasses.

   Expected output:

   Color of Circle: Red

   Color of Rectangle: Blue

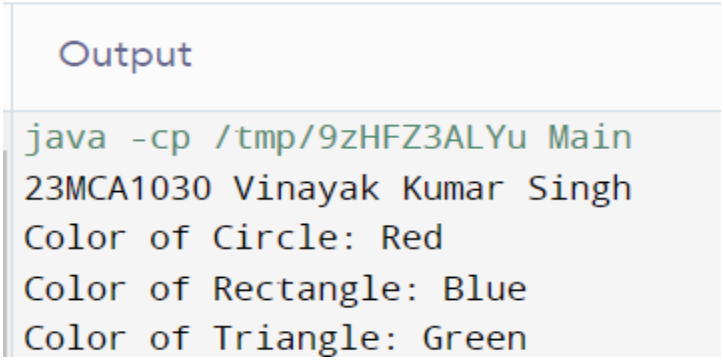
   Color of Triangle: Green

Code:

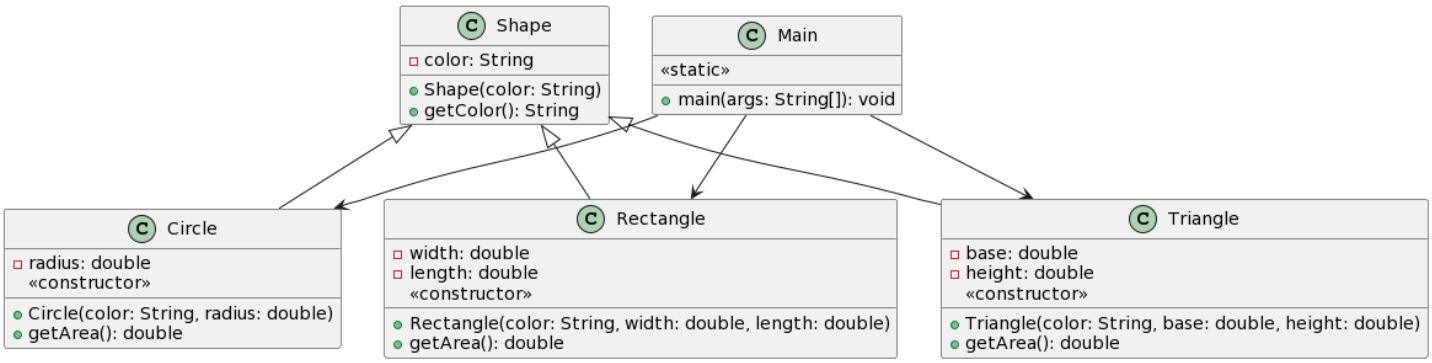
```
class Shape {
    protected String color;

    public Shape(String color) {
        this.color = color;
    }
    protected String getColor() {
        return color;
    }
}
class Circle extends Shape {
    public Circle(String color) {
        super(color);
    }
}
```

```
class Rectangle extends Shape {
    public Rectangle(String color) {
        super(color);
    }
}
class Triangle extends Shape {
    public Triangle(String color) {
        super(color);
    }
}
class Main {
    public static void main(String[] args) {
        Circle circle = new Circle("Red");
        Rectangle rectangle = new Rectangle("Blue");
        Triangle triangle = new Triangle("Green");
        System.out.println("23MCA1030 Vinayak Kumar Singh");
        System.out.println("Color of Circle: " + circle.getColor());
        System.out.println("Color of Rectangle: " + rectangle.getColor());
        System.out.println("Color of Triangle: " + triangle.getColor());
    }
}
```

Output:



Class diagram:



2. Extend the previous exercise by adding additional methods to the subclasses (Circle, Rectangle, Triangle) to calculate their respective areas. Use private attributes for dimensions (like radius, length, width, height) and ensure appropriate access to these attributes within the subclass methods.

   Expected output:

   Area of Circle with radius 5: 78.54

   Area of Rectangle with length 4 and width 6: 24.0

   Area of Triangle with base 3 and height 5: 7.5

Code:

```
class Shape {
    protected String color;
    public Shape(String color) {
        this.color = color;
    }
    protected String getColor() {
        return color;
    }
}


class Circle extends Shape {
    private double radius;
```

```
    public Circle(String color, double radius) {
        super(color);
        this.radius = radius;

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

class Rectangle extends Shape {
    private double length, width;
    public Rectangle(String color, double length, double width) {
        super(color);
        this.length = length;
        this.width = width;
    }
    public double getLength() {
        return length;
    }
    public double getWidth() {
        return width;
    }

    public double getRectangleArea() {
        return length * width;
```

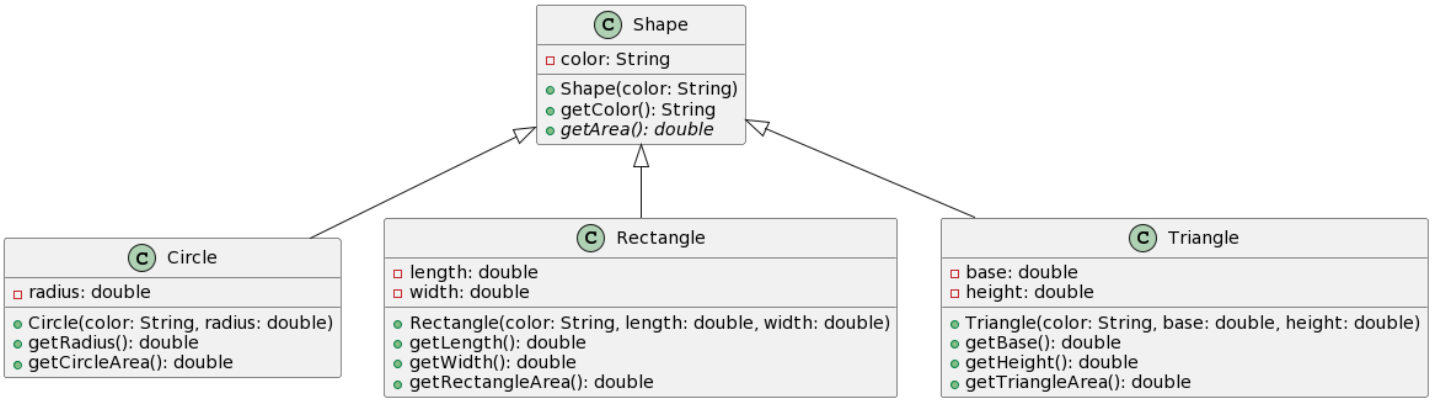
```
    }
}

class Triangle extends Shape {
    private double base, height;
    public Triangle(String color, double base, double height) {
        super(color);
        this.base = base;
        this.height = height;
    }
    public double getBase() {
        return base;
    }
    public double getHeight() {
        return height;
    }
    public double getTriangleArea() {
        return 0.5 * base * height;
    }
}

class Main {
    public static void main(String[] args) {
        Circle circle = new Circle("Red", 5);
        Rectangle rectangle = new Rectangle("Blue", 4, 6);
        Triangle triangle = new Triangle("Green", 3, 5);
        System.out.println("23MCA1030 Vinayak Kumar Singh");
        System.out.printf("Area of Circle with radius %.1f: %.2f\n", circle.getRadius(),
circle.getCircleArea());
```

```
        System.out.printf("Area of Rectangle with length %.1f and width %.1f: %.1f\n", rectangle.getLength(), rectangle.getWidth(), rectangle.getRectangleArea());

        System.out.printf("Area of Triangle with base %.1f and height %.1f: %.1f\n", triangle.getBase(), triangle.getHeight(), triangle.getTriangleArea());

    }

}
```

Output:

```
Output

java -cp /tmp/TjjbTk9BkQ Main
23MCA1030 Vinayak Kumar Singh
Area of Circle with radius 5.0: 78.54
Area of Rectangle with length 4.0 and width 6.0: 24.0
Area of Triangle with base 3.0 and height 5.0: 7.5
```

Class diagram:



3. Create a base class Book with private attributes like title, author, and public methods like getTitle() and getAuthor(). Then create subclasses like FictionBook and NonFictionBook inheriting from Book and add public methods to access specific attributes like getGenre() for FictionBook.

Expected input and output:

Title: The Great Gatsby

Author: F. Scott Fitzgerald

Title: Sapiens: A Brief History of Humankind

Author: Yuval Noah Harari

Genre: Non-Fiction

Code:

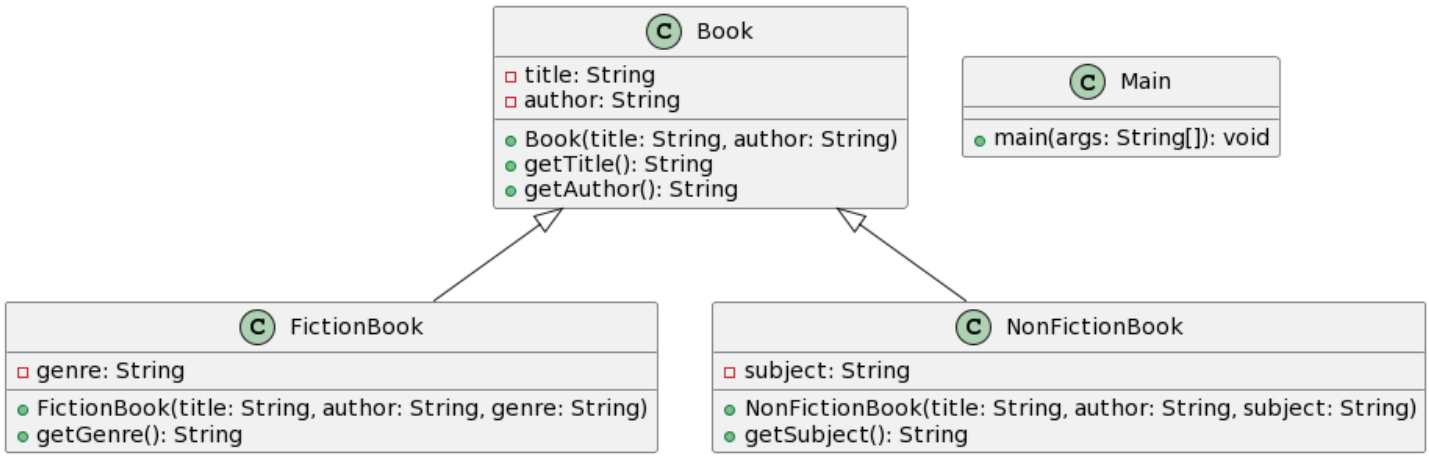
```
class Book {
    private String title;
    private String author;
    public Book(String title, String author) {
        this.title = title;
        this.author = author;
    }
    public String getTitle() {
        return title;
    }
    public String getAuthor() {
        return author;
    }
}

class FictionBook extends Book {
    private String genre;
    public FictionBook(String title, String author, String genre) {
        super(title, author);
        this.genre = genre;
    }
    public String getGenre() {
        return genre;
    }
}
```

```
class NonFictionBook extends Book {
    private String subject;
    public NonFictionBook(String title, String author, String subject) {
        super(title, author);
        this.subject = subject;
    }
    public String getSubject() {
        return subject;
    }
}


class Main {
    public static void main(String[] args) {
        FictionBook fictionBook = new FictionBook("The Great Gatsby", "F. Scott Fitzgerald", "Fiction");
        NonFictionBook nonFictionBook = new NonFictionBook("Sapiens: A Brief History of Humankind", "Yuval Noah Harari", "Non-Fiction");
        System.out.println("23MCA1030 Vinayak Kumar Singh");
        System.out.println("Title: " + fictionBook.getTitle());
        System.out.println("Author: " + fictionBook.getAuthor());
        System.out.println("\nTitle: " + nonFictionBook.getTitle());
        System.out.println("Author: " + nonFictionBook.getAuthor());
        System.out.println("Genre: " + nonFictionBook.getSubject());
    }
}
```

Output:

```
Output

java -cp /tmp/TjjbTk9BkQ Main
23MCA1030 Vinayak Kumar Singh
Title: The Great Gatsby
Author: F. Scott Fitzgerald

Title: Sapiens: A Brief History of Humankind
Author: Yuval Noah Harari
Genre: Non-Fiction
```

Class diagram:



4.Here's a partial version of the code with intentional issues that students need to fix:

```
// Abstract superclass Shape
abstract class Shape {
    private String color;
    public Shape(String color) {
        this.color = color;
    }
    public String getColor() {
        return color;
```

```
    }
    // Abstract method to get the area
    abstract double getArea();
}
// Subclass Circle inheriting from Shape
class Circle extends Shape {
    private double radius;
    public Circle(String color, double radius) {
        super(color);
        this.radius = radius;
    }
    // Implement the abstract method to calculate the area
    @Override
    double getArea() {
        return Math.PI * radius * radius;
    }
}
// Subclass Rectangle inheriting from Shape
class Rectangle extends Shape {
    private double width;
    private double length;
    public Rectangle(String color, double width, double length) {
        super(color);
        this.width = width;
        this.length = length;
    }
    // Implement the abstract method to calculate the area
    @Override
```

```
    double getArea() {
        return width * length;
    }
}
public class Main {
    public static void main(String[] args) {
        // Create objects of Circle and Rectangle
        Circle circle = new Circle("Red", 5);
        Rectangle rectangle = new Rectangle("Blue", 4, 6);

        // Print the color and area of each shape
        System.out.println("Color of Circle: " + circle.getColor());
        System.out.println("Area of Circle: " + circle.getArea());
        System.out.println("Color of Rectangle: " + rectangle.getColor());
        System.out.println("Area of Rectangle: " + rectangle.getArea());
    }
}
```

Students need to fix the following issues:

- Incomplete implementation of the Circle and Rectangle classes.
- Incorrect calculation of the area in the Circle and Rectangle classes.
- Missing implementation of the getArea() method in the Shape superclass.
- Access modifier issue in the getArea() method of the Shape superclass.

After fixing these issues, the program should compile and run correctly, producing the expected output with the color and area of each shape.

Corrected Code:

```
abstract class Shape {
    private String color;
    public Shape(String color) {
```

```
        this.color = color;
    }
    public String getColor() {
        return color;
    }
    // Corrected access modifier and added abstract keyword
    abstract double getArea();
}

// Subclass Circle inheriting from Shape
class Circle extends Shape {
    private double radius;
    public Circle(String color, double radius) {
        super(color);
        this.radius = radius;
    }
    // Implement the abstract method to calculate the area
    @Override
    double getArea() {
        return Math.PI * radius * radius;
    }
}
// Subclass Rectangle inheriting from Shape
class Rectangle extends Shape {
    private double width;
    private double length;
    public Rectangle(String color, double width, double length) {
        super(color);
```

```
        this.width = width;
        this.length = length;
    }
    // Implement the abstract method to calculate the area
    @Override
    double getArea() {
        return width * length;
    }
}

class Main {
    public static void main(String[] args) {
        // Create objects of Circle and Rectangle
        Circle circle = new Circle("Red", 5);
        Rectangle rectangle = new Rectangle("Blue", 4, 6);

        // Print the color and area of each shape
        System.out.println("23MCA1030 Vinayak Kumar Singh");
        System.out.println("Color of Circle: " + circle.getColor());
        System.out.println("Area of Circle: " + circle.getArea());
        System.out.println("Color of Rectangle: " + rectangle.getColor());
        System.out.println("Area of Rectangle: " + rectangle.getArea());
    }
}
```

Output:

```
Output

java -cp /tmp/TjjbTk9BkQ Main
23MCA1030 Vinayak Kumar Singh
Color of Circle: Red
Area of Circle: 78.53981633974483
Color of Rectangle: Blue
Area of Rectangle: 24.0
```

Class diagram: