Hands-on Experiment # 12: Worksheet

Section_______________ Date____________________________________

No more than 3 students per one submission of this worksheet.

Student ID ___________________________________ Name____

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Part A: Getting Familiar with Problem (Do not code here)

In this lab, we aim to write a program to draw many geometric shapes (Square, RightTriangle, Triangle) using standards keyboard characters. In order to draw a figure, there are 2 input parameters: character and the number of rows. Assume *rows* is 5,

- For Square, the number of characters in each row and column must be 5.
- For RightTriangle and Triangle, the number of characters is increased by 1 every row (up to 5).

***** ***** ***** ***** *****	% %% %%% %%%% %%%%%	# # # # # # # # # # # # # # #
Square	RightTriangle	Triangle

Assume the size is 6 rows using a character '*', **draw** the following shapes and **compute** their perimeters and areas.

	Square	RightTriangle	Triangle
Draw	* *	* *	* * * * * * * * * * * * * * * * * * * * *

Perimeter	Character = '*'
	Row = 6
		Character = '*'
		Row = 6
			Character = '*'
			Row = 6

Area	36	18	18

Draw the above RightTriangle when it is vertical flip and draw the above Trianlge when it is horizontal flip.

	RightTriangle (Vertical Flip)	Triangle (Horizontal Flip)
Draw	* *	* * * * * * * * * * * * * * * * * * * * *

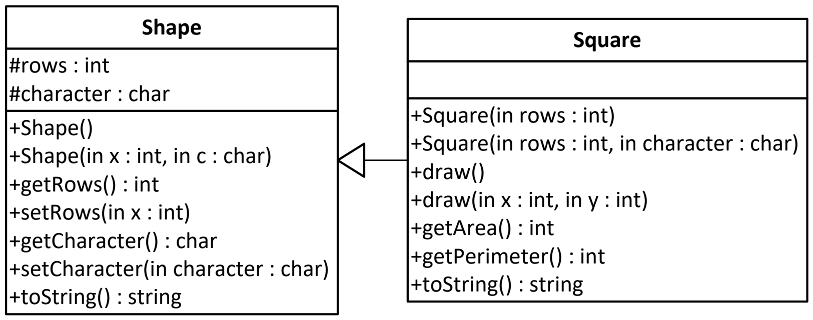
Assume we can draw each shape at a position (x, y), where x is an indent (the number of spaces) and y is the starting row. Please draw a rectangle at the position (5, 2) when *rows*=6 and *character*='*'. From this example, there are 5 indents (x) and the starting row is 2 (y).

	Square	RightTriangle	Triangle

Draw	`* * * * * *`
	`* * * * * *`
	`* * * * * *`
	`* * * * * *`
	`* * * * * *`
	`* * * * * *`
		`*`
		`* *`
		`* * *`
		`* * * *`
		`* * * * *`
		`* * * * * *`
			`     *`
			`    * *`
			`   * * *`
			`  * * * *`
			` * * * * *`
			`* * * * * *`

Part B: Design Your Class (Do not code here)

The below figure shows a part of the program: Shape and Square. Shape is a superclass of any shapes and there are 2 *protected* variables (rows and character) – represented by the "#" symbol.



Class "Shape"

- There are two properties (variables): *rows* and *character*
- There are 2 constructors.
- There are getter & setter methods for all properties (variables).
- toString() shows all variables' value; e.g., "rows=5 and character=*"

Class "Square"

- There are 2 constructors.
- draw(): to draw a square without indent and starting row.
- draw(int x, int y): to draw a square with *x* indents and starting row at *y*.
- getArea() and getPerimeter() to compute area and perimeter of the object.
- toString() shows object's information; e.g., "Square: rows=5 and character=*".

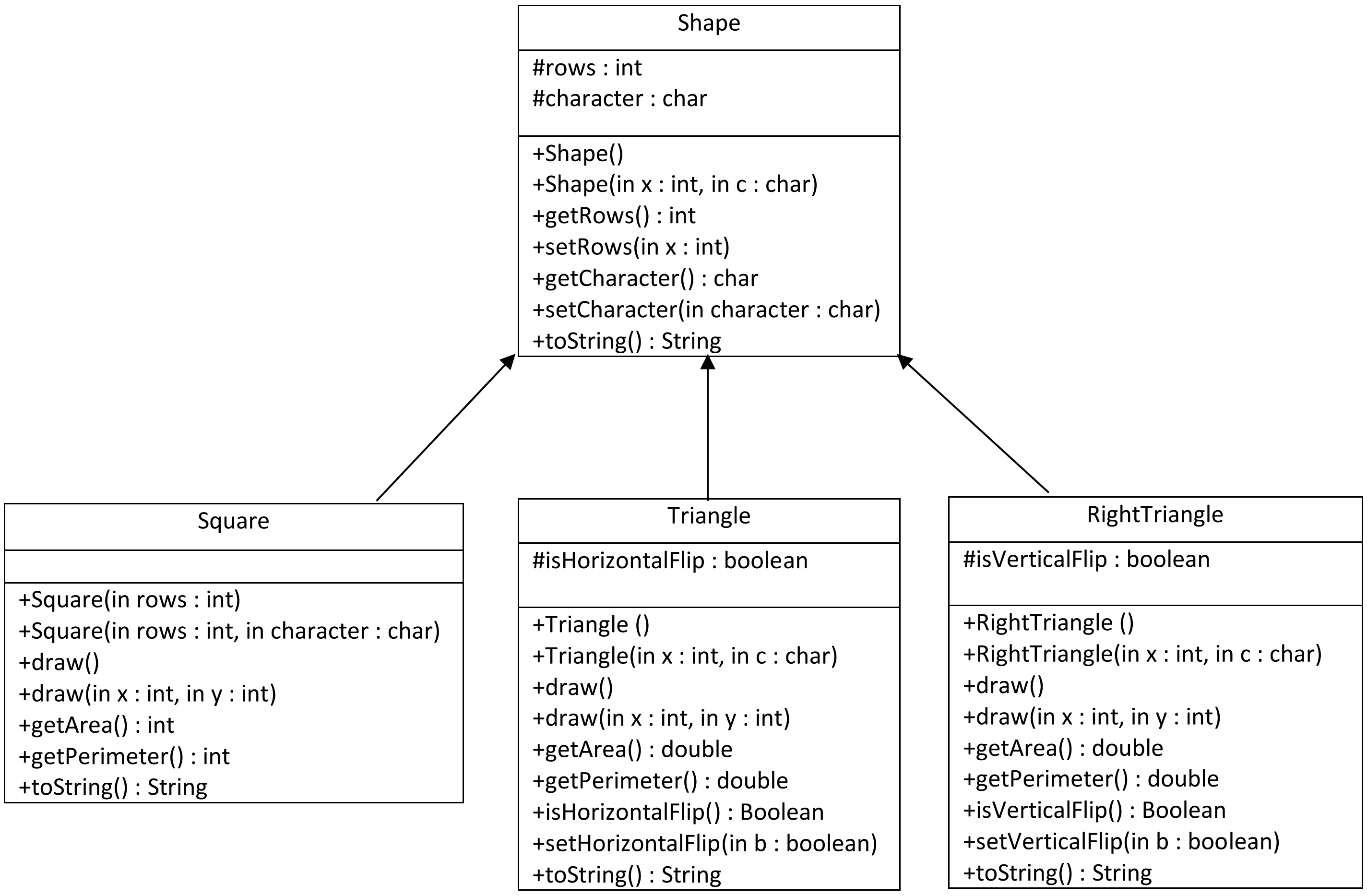
If the variables (*rows* and *character*) in Shape are *private*, can the following code inside Square still be able to compile? If not, why?

```
// Inside the Square class
public void test1(){
        int side = rows;
}
```

No, it cannot because the attribute(row) is private from other classes.

Write UML diagram of all shapes including: Shape, Square, Triangle, RightTriangle

- In Triangle, there is a variable called “isHorizontalFlip”. If it is true, the figure is horizontal flipped.
    - In order to get and set this variable, there are 2 extra methods: boolean isHorizontalFlip() and void setHorizontalFlip(boolean isHorizontalFlip).
- In RightTriangle, there is a variable called “isVerticalFlip”. If it is true, the figure is vertical flipped.
    - In order to get and set this variable, there are 2 extra methods: boolean isVerticalFlip() and void setVerticalFlip(boolean is VerticalFlip).


Shape
#rows : int
#character : char
+Shape()
+Shape(in x : int, in c : char)
+getRows() : int
+setRows(in x : int)
+getCharacter() : char
+setCharacter(in character : char)
+toString() : String
Square
+Square(in rows : int)
+Square(in rows : int, in character : char)
+draw()
+draw(in x : int, in y : int)
+getArea() : int
+getPerimeter() : int
+toString() : String
Triangle
#isHorizontalFlip : boolean
+Triangle ()
+Triangle(in x : int, in c : char)
+draw()
+draw(in x : int, in y : int)
+getArea() : double
+getPerimeter() : double
+isHorizontalFlip() : Boolean
+setHorizontalFlip(in b : boolean)
+toString() : String
RightTriangle
#isVerticalFlip : boolean
+RightTriangle ()
+RightTriangle(in x : int, in c : char)
+draw()
+draw(in x : int, in y : int)
+getArea() : double
+getPerimeter() : double
+isVerticalFlip() : Boolean
+setVerticalFlip(in b : boolean)
+toString() : String

Part C: Coding

Implement all classes based on your design in Part B. What is the result of TestDraw.java (code below)?

```
public class TestDraw {
		public static void main(String[] args) {
			Triangle head = new Triangle(7, '*');
			Square tail = new Square(5, '*');
			head.draw();
			tail.draw(5, 0);
		}
}
```

```
      *

     * *

    * * *

   * * * *

  * * * * *

 * * * * * *

* * * * * * *

     * * * * * *

     * * * * * *

     * * * * * *

     * * * * * *

     * * * * * *

     * * * * * *
```

Modify TestDraw.java to draw the following figure.

```
                    #
                   # #
                  # # #
                 # # # #
                # # # # #
               # # # # # #
              # # # # # # #
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%%%%%%%%%%%%%%%
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%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%
      &       &
     &&       &&
    &&&       &&&
   &&&&       &&&&
  &&&&&       &&&&&
 &&&&&&       &&&&&&
&&&&&&&       &&&&&&&
```
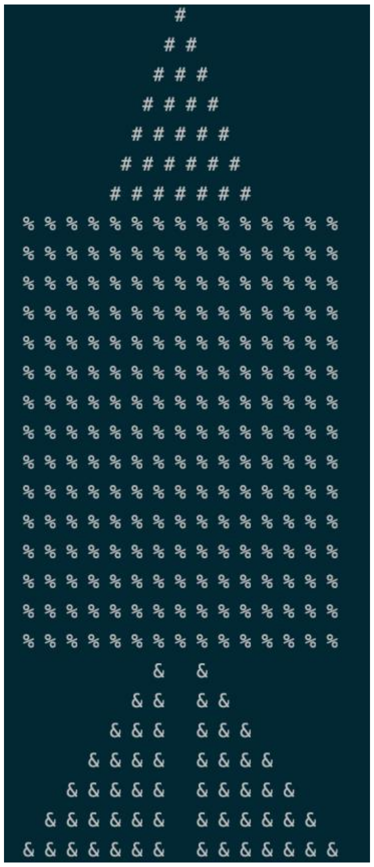

Include the screenshots below.



```
              #
             # #
            # # #
           # # # #
          # # # # #
         # # # # # #
        # # # # # # #
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      & & & &   & & & &
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  & & & & & &   & & & & & &
& & & & & & &   & & & & & & &
```

List all your source code here.

```
public class Shape {
  protected int rows;
  protected char character;

  public Shape() {
  };

  public Shape(int x, char c) {
    rows = x;
    character = c;
  }

  public int getRows() {
    return rows;
  }

  public void setRows(int x) {
    this.rows = x;
  }

  public char getCharacter() {
    return character;
  }

  public void setCharacter(char character) {
    this.character = character;
  }

  public String toString() {
    return "rows:" + rows + " character:" + character;
  }

}
```

```java
public class Square extends Shape {

   public Square(int rows) {
      this.rows = rows;
      this.character = '*';
   }

   public Square(int rows, char character) {
      this.rows = rows;
      this.character = character;
   }

   public void draw() {
      for (int i = 1; i <= rows; i++) {
         for (int j = 1; j <= rows; j++)
            System.out.print(character + " ");
         System.out.println();
      }
   }

   public void draw(int x, int y) {
      x++; // adjusting x position
      y++; // adjusting y position
      for (int i = 1; i <= rows + y; i++) {
         if (i >= y) { // only prints character after y rows
            for (int j = 1; j <= rows + x; j++) {
               if (j >= x) // only prints character after x spaces
                  System.out.print(character + " ");
               else
                  System.out.print(" "); // otherwise prints whitespace
            }
         }
         System.out.println(); // moves to next line
      }
   }
```

```
    public int getArea() {
        return rows * rows;
    }

    public int getPerimeter() {
        return 4 * rows;
    }

    public String toString() {
        return "Square: rows:" + rows + " character:" + character;
    }

}



public class Triangle extends Shape {

    private boolean isHorizontalFlip;

    public Triangle(int rows) {
        super.rows = rows;
        super.character = '#';
        isHorizontalFlip = false;
    }

    public Triangle(int rows, char character) {
        super.rows = rows;
        super.character = character;
        isHorizontalFlip = false;
    }

    public void draw() {
        if (isHorizontalFlip) {
            for (int i = rows; i >= 1; i--) {
                for (int k = 1; k <= rows - i; k++)
                    System.out.print(" ");
                for (int j = 1; j <= i; j++) {
                    System.out.print(character + " ");
                }
                System.out.println();
            }
        } else {
            for (int i = 1; i <= rows; i++) {
                for (int k = 1; k <= rows - i; k++)
                    System.out.print(" ");
                for (int j = 1; j <= i; j++) {
                    System.out.print(character + " ");
                }
                System.out.println();
            }
        }
    }

    public void draw(int x, int y) {
        x++;
        y++;
        if (isHorizontalFlip) {
            for (int i = rows + y - 1; i >= 1; i--) {
                if (rows - i + 1 >= y) {
                    if (isHorizontalFlip()) {
                        for (int k = 1; k <= rows - i; k++)
                            System.out.print(" ");
                    }
                    for (int j = 1; j <= i + x - 1; j++) {
                        if (j >= x)
                            System.out.print(character + " ");
                        else
                            System.out.print(" ");
                    }
                }
                System.out.println();
            }
        } else {
            for (int i = 1; i <= rows + y - 1; i++) {
                if (i >= y) {
                    for (int k = 1; k <= rows - i; k++)
                        System.out.print(" ");
                    for (int j = 1; j <= i + x - 1; j++) {
                        if (j >= x)
                            System.out.print(character + " ");
                        else
                            System.out.print(" ");
                    }
                }
                System.out.println();
            }
        }
    }

    public double getArea() {
        return 0.5 * rows * rows / Math.tan(60);
    }

    public double getPerimeter() {
        return 3 * rows / Math.sin(60);
    }

    public String toString() {
        return "Square: rows:" + rows + " character:" + character + " isHorizontalFlip:" +
isHorizontalFlip;
    }

    public boolean isHorizontalFlip() {
        return isHorizontalFlip;
    }

    public void setHorizontalFlip(boolean isHorizontalFlip) {
        this.isHorizontalFlip = isHorizontalFlip;
    }

}



public class RightTriangle extends Shape {

    private boolean isVerticalFlip;

    public RightTriangle(int rows) {
        super.rows = rows;
        super.character = '%';
        isVerticalFlip = false;
    }

    public RightTriangle(int rows, char character) {
        super.rows = rows;
        super.character = character;
        isVerticalFlip = false;
    }

    public void draw() {
        for (int i = 1; i <= rows; i++) {
            if (isVerticalFlip) { // when vertical flipped print some whitespaces first to push the
triangle to
                                  // the right
                for (int k = 1; k <= rows - i; k++)
                    System.out.print("  ");
            }
            for (int j = 1; j <= i; j++) {
                System.out.print(character + " ");
            }
            System.out.println();
        }
    }
```

```java
public void draw(int x, int y) {
    x++;
    y++;
    for (int i = 1; i <= rows + y; i++) {
        if (i >= y) {
            if (isVerticalFlip) {
                for (int k = 1; k <= rows - i; k++)
                    System.out.print("  ");
            }
            for (int j = 1; j <= i + x; j++) {
                if (j >= x)
                    System.out.print(character + " ");
                else
                    System.out.print(" ");
            }
        }
        System.out.println();
    }
}

public void drawDoubleTriangle(int space) { // for the two triangle at the last part
    for (int i = 1; i <= rows; i++) {
        // Left triangle
        for (int k = 1; k <= rows - i; k++)
            System.out.print("  ");
        for (int j = 1; j <= i; j++) {
            System.out.print(character + " ");
        }

        for (int index = 1; index <= space; index++)
            System.out.print(" ");

        // Right triangle
        for (int j = 1; j <= i; j++) {
            System.out.print(character + " ");
        }
```

```
            System.out.println();
        }
    }

    public double getArea() {
        return 0.5 * rows * rows;
    }

    public double getPerimeter() {
        return 2.0 * rows + Math.sqrt(2.0 * rows * rows);
    }

    public String toString() {
        return "RightTriangle: rows:" + rows + " character:" + character + " isVerticalFlip:" +
isVerticalFlip;
    }

    public boolean isVerticalFlip() {
        return isVerticalFlip;
    }

    public void setVerticalFlip(boolean isVerticalFlip) {
        this.isVerticalFlip = isVerticalFlip;
    }

}
```

Submit this worksheet (by only one member of the group) via http://www.myCourseVille.com (Assignments > Hands-on Experiment # 12) before noon of the day after your lecture.