Final exam TIC - 409

You are building your photo editing software. In this software, you can create different types of shapes. You can create Rectangles, Circles & Triangles. Each of those shapes has a **width** and **height** (And each of them has default values).

The **Canvas** class represents the drawing area. It has a **draw** method that takes different shapes and draws them on the canvas.

To be able to draw any shape, we will use a **ShapeDrawer** class.
To track user's activity, we will use a **ActivitySystem** class.
And finally, for better organisation, we will use Groups to group shapes.

N.B. Questions are independent (except for 3.d.), so you can choose which order to do them in.

Questions

1. Since we need 1 **ShapeDrawer**, it doesn't make sense that we can create multiple **ShapeDrawer** objects. We also had to send the **ShapeDrawer** to each and every shape in their constructor so that they can ask to be drawn.

    a. Transform the **ShapeDrawer** into a ***Singleton** to solve both those problems*.

    b. Make all the necessary changes to use the newly updated **ShapeDrawer.**

    ```
    Drawing: Shape{width=5, height=5}
    Drawing: Shape{width=3, height=3}
    Drawing: Shape{width=4, height=4}
    ```

2. To be able to track the user's actions, we want to create a **ActivitySystem**. This system will *observe* the creation of any Shapes or Groups as well as the changing of any of the shapes' width or heights. And whenever any of those actions are done, it will print something to the console.

    a. Create the **ActivitySystem** class using the ***observer pattern***.

    b. Make the necessary changes in the Shape's class to *notify* the activity system whenever a new Shape is created. The activity system should print out `[ACTIVITY] New shape was created`

    c. Make the necessary changes in the Shape's class to *notify* the activity system whenever the Shape's width or height changes. The activity system should print out `[ACTIVITY] Shape size was changed`

    d. Make the necessary changes in the Group's class to *notify* the activity system whenever a new Group is created. The activity system should print out `[ACTIVITY] New group was created`

    ```
    [ACTIVITY] New shape was created
    [ACTIVITY] New shape was created
    [ACTIVITY] New shape was created
    [ACTIVITY] New group was created
    [ACTIVITY] New group was created
    [ACTIVITY] Shape size was changed
    ```

3. For easier organisation, the user can group multiple shapes in **Groups**. Each **Group** can contain one or many **shapes** or **groups**. A Group's width is the total width of all the contained elements in it and its height is the height of

the biggest element.

a. Update the **Group** class using the relevant pattern (A group can contain a Group or a Shape) so that we are able to add both Groups and Shapes in Group)

b. Create 2 groups (g1 & g2)

c. Print both the width and height for each of the groups and verify that it works well.

```
Group{width=8, height=5}
Group{width=12, height=5}
```