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**GTU Department of Computer Engineering
CSE443 Object Oriented Analysis and Design
Fall 2021 - Homework 1 Report**

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1 Problem Definition

The problem is to implement a **2D side-scrolling video game** with the help of strategy and decorator design patterns.

2 Solution

The homework was finished **fully** as expected in homework pdf file.

2.1 Game Loop

In order to make a game with java, there must be a game loop. In state of the art, there are more than one way to create a game loop. But must preferred one is game loop using **thread**.

2.1.1 Creating a Thread

```
1  /**
2   * This is the game screen to put things on.
3   * Also, it works as separate thread to create a game loop.
4   */
5  public class MainJPanel extends JPanel implements Runnable, KeyListener {
6      ...
7  }
8
9  //create thread
10 public class MainWindow extends JFrame {
11
12     private MainJPanel contentPanel;
13     private Thread gameThread;
14
15     public void createThread() {
16         try {
17
18             gameThread = new Thread(contentPanel);
19         } catch (Exception e) {
20             e.printStackTrace();
21         }
22     }
23
24
25     public void startThread() {
26         gameThread.start();
27     }
28
29     ...
30
31 }
```

2.1.2 FPS

One of the challenging part setting of the fps. In order to set FPS default to 60, I have used "System.nanoTime()" function in java. Because;

1 second = 1.000.000.000 nanoseconds.

Then we will divide nano time with 60;

$1.000.000.000/60 = 16.666.666,66$ nanoseconds. = 0.01666 second = 60 FPS

2.1.3 Game Loop with 60 FPS

```
1 // MainJPanel class override run method
2 @Override
3 public void run() {
4     //FPS = 60
5     double fpsMS = 1000000000 / FPS;
6     double deltaTime = 0;
7     long lastTime = System.nanoTime();
8     long currentTime;
9     long counter = 0;
10    int numberOfDraw = 0;
11
12    //game will continue until you exit
13    while (true) {
14        currentTime = System.nanoTime();
15        deltaTime += (currentTime - lastTime) / fpsMS;
16        counter += (currentTime - lastTime);
17        lastTime = currentTime;
18
19        if (deltaTime >= 1) {
20            //update
21            //repaint
22            deltaTime--;
23            numberOfDraw++;
24        }
25
26        if (counter >= 1000000000) {
27            currentFPS = numberOfDraw;
28            numberOfDraw = 0;
29            counter = 0;
30        }
31    }
32 }
```

2.2 Drawing Components

In order to draw things on screen I used **Graphics** class in java. For example;

```
1 /**
2  * Paint main character(circle) on screen using Graphics object.
3  * @param g Graphics object
4  */
5 public void draw(Graphics g) {
6
7     Graphics2D g2 = (Graphics2D) g;
8     g2.setStroke(new BasicStroke(3f));
9     g2.setColor(Color.decode("#f84545")); // red color
10    g2.fill(new Ellipse2D.Double(150, cor.getyStart(), 30, 30));
11 }
```

2.3 Creating Animation

In order to create simple animation which is background that moves, while the character always remains at a fixed spot on the screen, I draw **colored rectangles** and combine them to create a simple road. Then, I just change **x position** of them and with the **repaint()** function they create simple animation. For example;

```

1  /**
2   * Update position of road
3   * Stones are simple rectangles
4   * */
5  public void updateRoad(int distance) {
6      for (RoadStone stone : stoneList) {
7          stone.setX(stone.getX() - distance);
8      }
9      RoadStone stone2 = stoneList.get(0);
10     if (stone2.getX() + 50 < 0) {
11         stone2.setX(stoneList.get(stoneList.size() - 1).getX() + 50);
12         stoneList.add(stone2);
13         stoneList.remove(0);
14     }
15 }

```

2.3.1 Implemented Animation



Figure 1: Picture from Game

2.4 Design Patterns

This game was implemented by using strategy and decorator design patterns.

2.4.1 Strategy Design Pattern

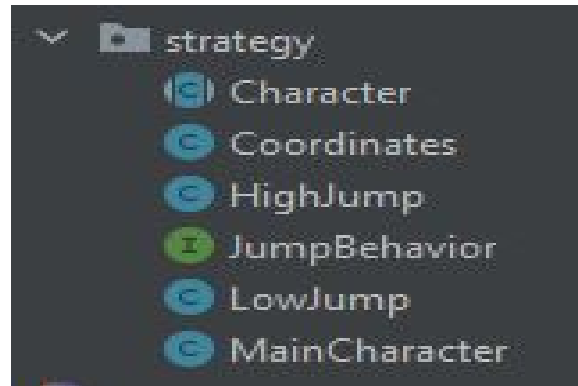


Figure 2: Classes in Strategy Design Pattern

Character is abstract class and JumpBehavior is an interface.

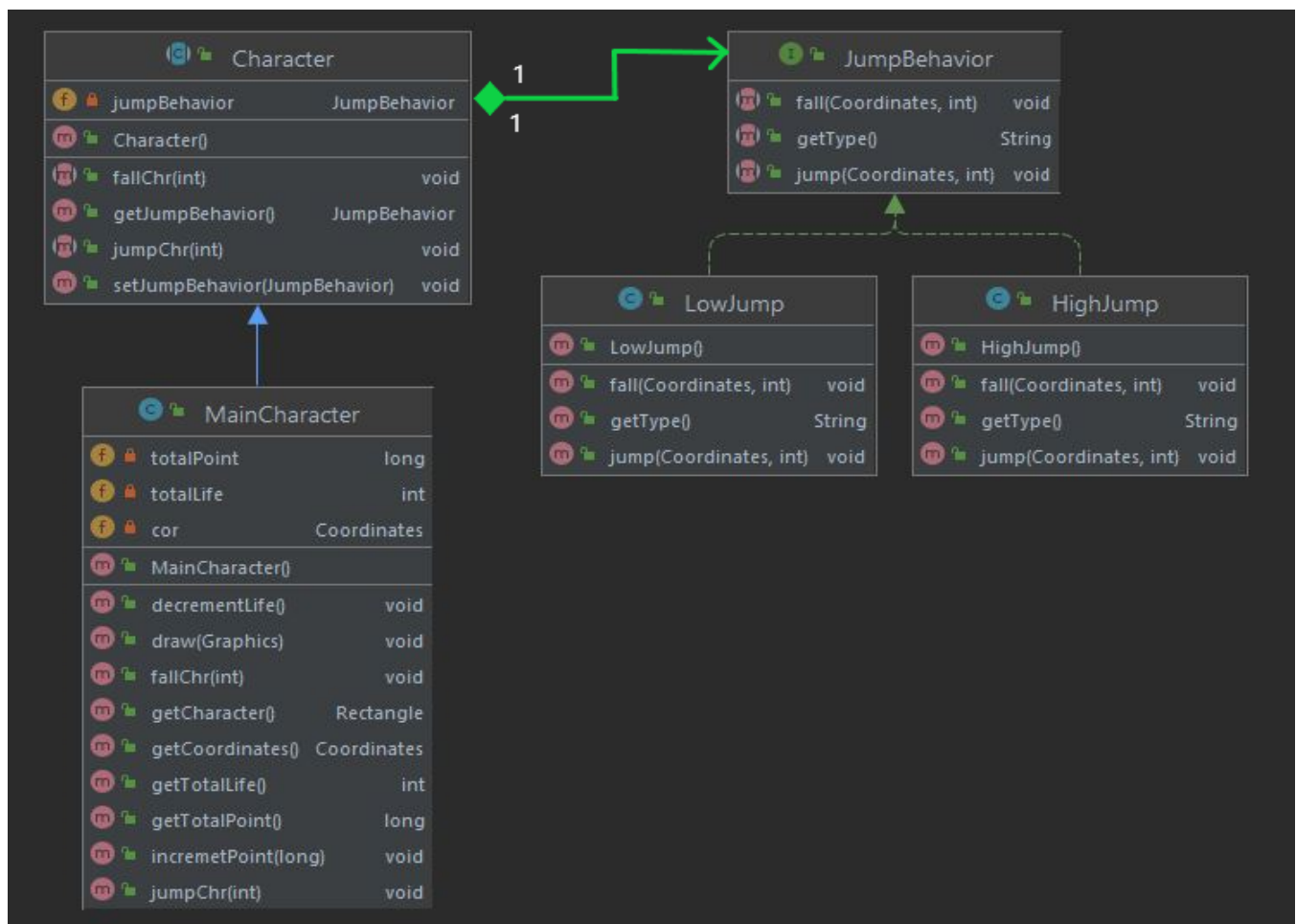


Figure 3: Simple Class Diagram for Strategy Design Pattern

2.4.2 Decorator Design Pattern

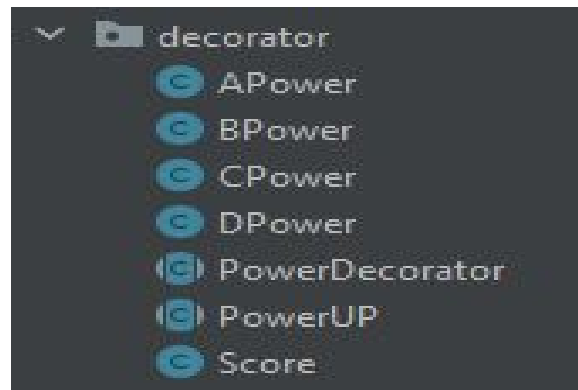


Figure 4: Classes in Decorator Design Pattern

PowerUP and PowerDecorator are abstract classes.

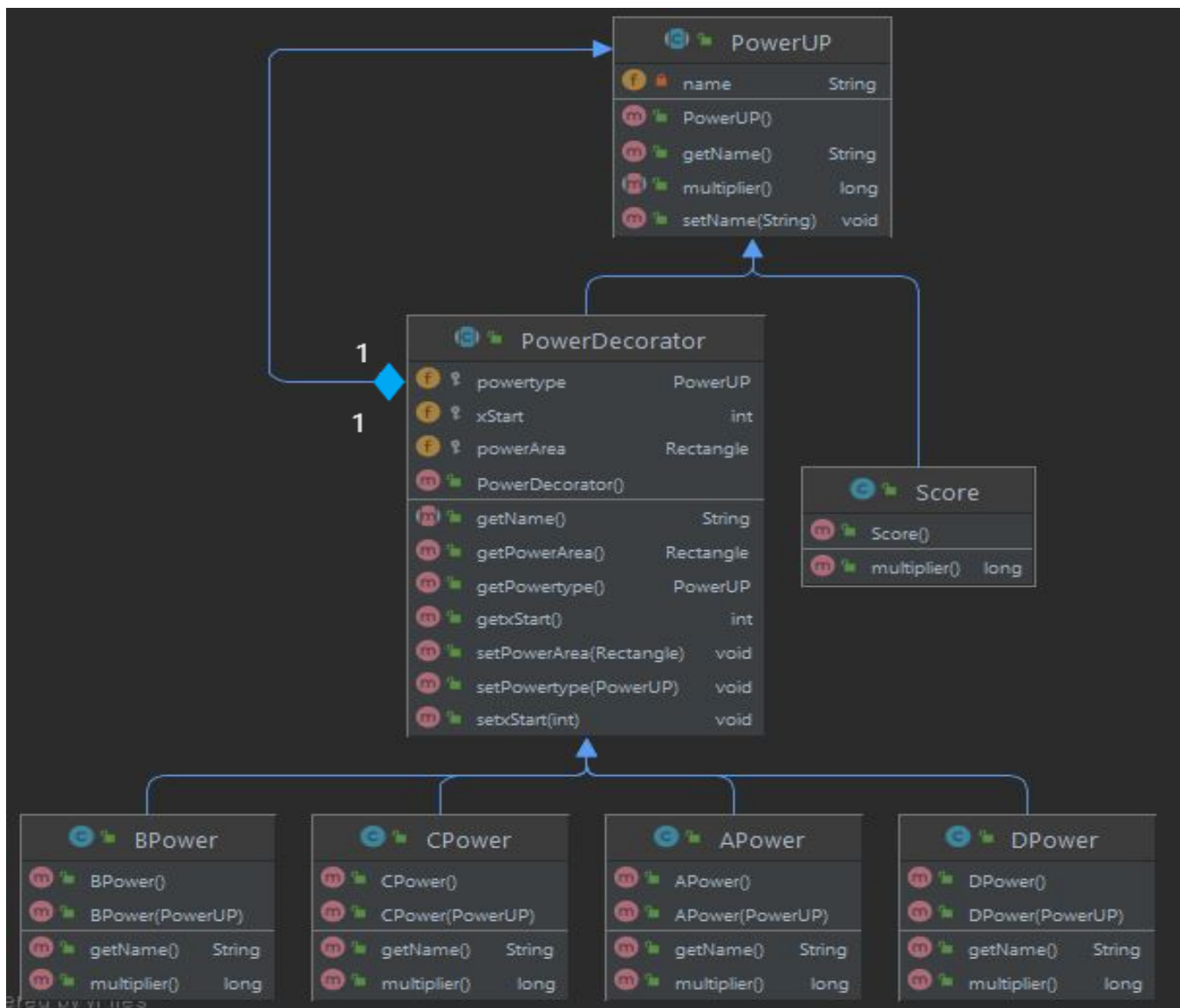


Figure 5: Simple Class Diagram for Decorator Design Pattern

3 Class Diagrams

In order to see class diagrams check class diagrams folder.

4 References that was used

- ▶ Head First Design Patterns, 2nd Edition.
- ▶ Online sources to learn java gui.
- ▶ Eclipse editor to implement java gui.
- ▶ IntelliJ IDEA editor to create class diagrams.