

Software Design - CSSE 374

Second Exam

Due: Monday, Feb 18th 2012, 8:00 AM

Assumption

1. All of the questions for this exam are based on the Eclipse Java project provided to you at: <http://www.rose-hulman.edu/class/csse/csse374/Exams/FinalExamProject.zip>. Feel free to load this into some environment like Eclipse if you like, but you will not need to do any actual programming.
2. Collaboration is not allowed. The exam is open book, and you are free to consult any non-human resources. (Although asking a question that is answered by some remote person is, of course, also collaboration.)
3. Both electronic and paper copy of the exam are acceptable, however, we must be able to read your answers. If you turn in a paper copy while we are not in our offices, please slide it under the door!

Context

Assume that a fictitious sophomore student named Trinity is in our CSSE department. She is building a game development framework for coding arcade games in Java. This framework is intended to provide support for rendering graphics objects and using game controllers (such as PS3 and Xbox game controllers) in at least three operating systems: Linux, Mac, and Windows.

As you can see in the source code, Trinity has already developed some of the graphical objects such as Point, Line, Circle, Rectangle, and so on. She wants to combine these objects together to form more complex objects such as a Car, Road, House, Mountains, Rivers, and so on.

Trinity has taken most of the systems courses at Rose, hence, it would be safe to assume that she knows how to receive interrupts from hardware, render graphical objects on a monitor using operating system specific API calls, and other details to get the framework to talk with the underlying hardware. For the sake of brevity, it can be assumed that the current version of Canvas and PS3Controller that she has developed are functional.

Even though she is good with low-level programming, she has not yet taken CSSE 374 and knows very little about software design. She needs your help to develop an extensible framework that follows all of the known principles (GRASP and SOLID) and patterns (Gang of Four).

Problems

1. Based on the problem context, given source code, comments, and current implementation, identify flaws in her current design. Frame those flaws as violations of known design principles. Please exhaust all possibilities. **(20 points)**

Hint: We are looking for identification and discussion of existing problems here, not redesign or drawings of a redesign. Think “bad smells.”

2. The graphical objects that she has implemented so far have room for improvement. Using UML class diagram, explain what can be improved in the design of her graphical objects including the Canvas object. Your design should make her framework more extensible, platform independent, and should also support creation of complex shapes from simpler ones. List all of the design patterns that you have used in your new design. **(30 points)**

3. Identify the design pattern used in PS3Controller. Explain why this pattern is a bad choice. Using UML class diagram, show a better design that could be adopted by game controllers in her framework. Please focus on high-level design rather than the implementation details. List all of the design patterns that you have used in your new design. **(30 points)**

4. Assume everything covered by Questions 1-3 have been fixed or implemented at this point in Trinity's framework, and consider the following:

The graphical objects used in Trinity's framework rely on the Cartesian coordinate system. It is well-known that Fractals could be used to easily create real-life complex objects such as mountains, rivers, and grass lands on computers. Fractals at times are better represented in Polar coordinate system, (r, θ) than in Cartesian coordinate system, (x, y) . Trinity has now completed most of her implementation and does not want to re-write her graphical objects to support the Polar coordinate system. Nevertheless, given a polar coordinate $(r$ and $\theta)$, she knows that she can derive the corresponding Cartesian coordinate as $(r * \cos(\theta), r * \sin(\theta))$. Assume that she uses the code below to represent a point in Polar coordinate system. Using UML class diagram, show her how she could make her framework work with Polar coordinates without modifying her existing graphical objects' code. **(20 points)**

```
public class PolarPoint {
    private double radius;
    private double theta;

    public PolarPoint(double radius, double theta) {
        this.radius = radius;
        this.theta = theta
    }

    public double getRadius() {
        return radius;
    }

    public double getTheta() {
        return theta;
    }
}
```