Design and Design Patterns

Design Patterns

Design Patterns use OO-principles to solve common problems.

Singletons: The OO answer to global variables.

Why not use globals?

A. They make code hard to understand.

B. They make code hard to debug.

C. They make code hard to modify.

Why not use globals?

D. Profs O'Neill and Kuenning with haunt your dreams if you do.

Answer

All of the above.

Singleton Pattern

- Problem: Ensure a class has only one instance and provide a global point of access to that instance.

Singleton Class

```
class Singleton
{
public:
        static Singleton* Instance();
private:
        static Singleton* theSingletonInstance;
        Singleton() {};
        ~Singleton() {};
        Singleton(const Singleton& toCopy) {};
        Singleton& operator=(const Singleton& toCopy) {};

};

Singleton::Singleton* theSingletonInstance = NULL;
```

Instance Implementation

```
Singleton* Instance()
{
        if (theSingletonInstance == NULL)
                theSingletonInstance = new Singleton;
        return theSingletonInstance;
}
```

Access

```
Singleton* ptrTheSingleton = Singleton::Instance;
```

Example

```
class Ball
{
public:
        static Ball* theBall();
private:
        Sphere   theSphere;
        Ball() {};
        ~Ball() {};
};

Ball::Ball* theBall = NULL;
```

new problem

I want a 2D graphics library that supports the following functions for triangles:

- set color to r,g,b
- translate vertices by dx, dy, dz
- rotate α degrees about the origin
- draw

help

I have a 3D graphics library that has a triangle class with the following interface

- triangle()
- triangle(v1x, v1y, v1z, v2x, v2y, v2z, v3x, v3y, v3z)
- ~triangle()
- set color(r, g, b)
- rotate(vector, angle)
- translate(dx, dy, dz)
- scale(sx, sy, sz)
- draw()
- flip(planeA, planeB, planeC, planeD)
- texture(textureMap)
- standardize()

exercise

Design a 2D triangle class that uses the 3D class to do the work!

façade

- Scenario — You need to use a subset of a complex system or you need to interact with the system in a particular way.
- Problem — You want to simplify how the complex system is used to fit your application.

another problem

- I want a 2d shape class that supports lines.
- I want to draw these lines using one of two drawing programs. The exact choice of drawing program will be decided when the class is instantiated. The drawing calls are:
  - Draw program 1: drawLine(x1,y1,x2,y2)
  - Draw program 2: drawALine(x1,x2,y1,y2)
- In the future I may want to add other shapes and other drawing programs.

exercise

- draw UML diagrams for two different designs
- describe the tradeoffs

solution 1

```
draw() {
  if (drawPackage == 1)
      drawLine(v1.x, v1.y, v2.x, v2.y)
  else
      drawALine(v1.x, v2.x, v1.y, v2.y)
}
```

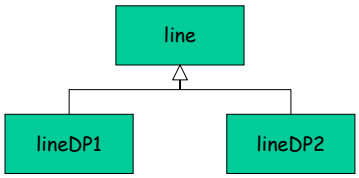
solution 1

- Advantages
- Disadvantages

solution 1

- Advantages
  - simple to implement
  - simple to understand
- Disadvantages
  - as additional shapes are added we violate a variation on the "No Forgery" principle called "One Rule, One Place"

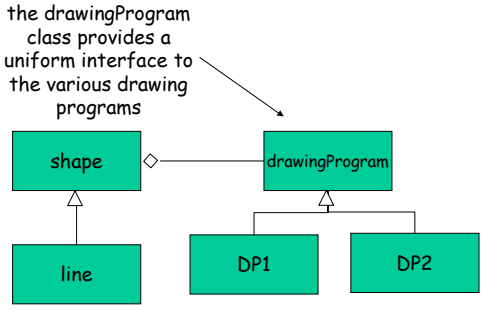
solution 2



solution 2

- Advantages
  - simple to implement
  - simple to understand
- Disadvantages
  - as additional shapes and drawing programs are added the number of classes becomes LARGE

solution 3: bridge



bridge

- scenario: derived class needs to use multiple implementation
- problem: you want to follow "one rule, one place" and still avoid an explosion in number of classes