M6 (b) - Composition

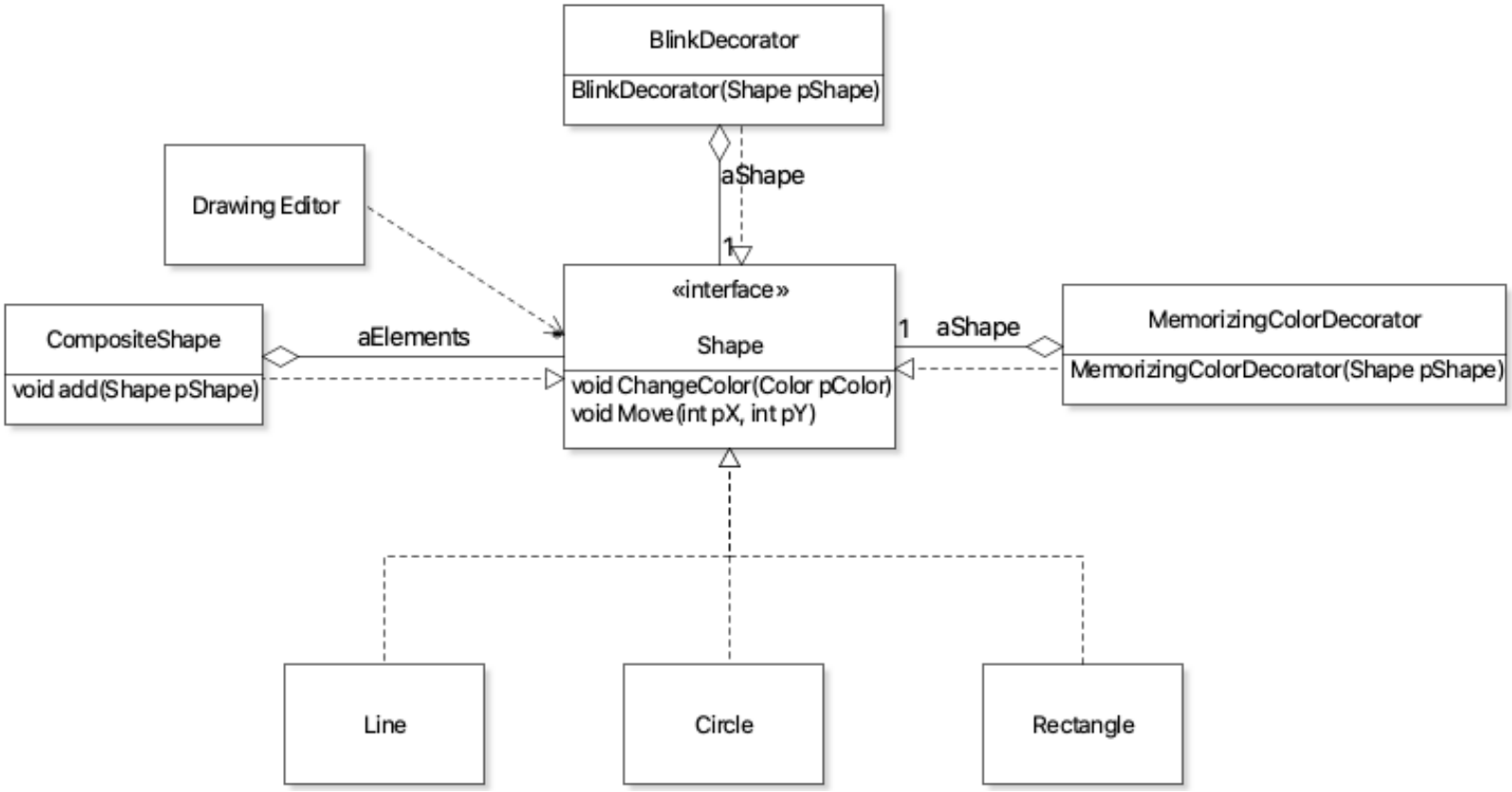
Jin L.C. Guo

Image source: https://cdn.pixabay.com/photo/2017/11/05/21/21/container-2921882_960_720.jpg

Objective

- Polymorphic Object Cloning
- Prototype Pattern

So far, our design of shapes:



```java
/**
 * Aggregate a collection of shapes.
 * The client can get shapes and
 * add new shape on demand
 *
 */
public class ShapeManager
{
    private final List<Shape> aShapes = new ArrayList<>();

    public List<Shape> getShapes()
    {
        // return a copy of aShapes;
    }

    public void addShape(Shape pShape)
    {
        // add a copy of pShape;
    }
}
```

Object Copying

- Copy Constructor

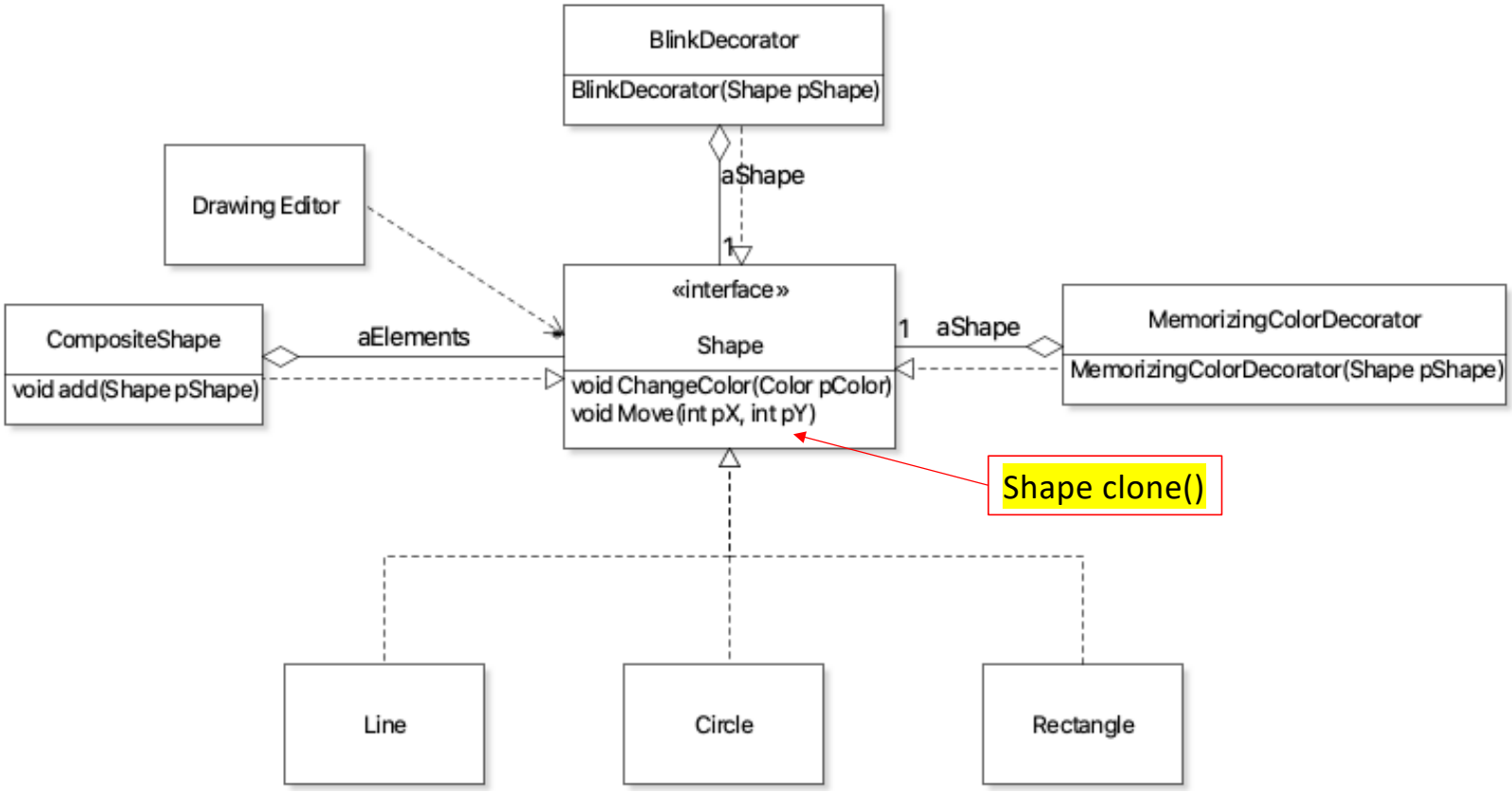
```
public  Line(Line pLine) {
    this.x_start = pLine.x_start;
    this.y_start = pLine.y_start;
    this.x_end = pLine.x_end;
    this.y_end = pLine.y_end;
}
```

- Static factory method

```
public static Line newInstance(Line pLine)
{
    return new Line(pLine);
}
```

```
public List<Shape> getShapess()
{
    // return a copy of aShapes;
    List<Shape> shapesCopy = new ArrayList<>();
    for(Shape sp:aShapes)
    {
        if (sp instanceof Line)
        {
            shapesCopy.add(new Line(sp));
        }
        else if (sp instanceof Circle)
        {
            shapesCopy.add(new Circle(sp));
        }
        else if (sp instanceof CompositeShape)
        {
            ……
        }
        ……
    }
    return shapesCopy;
}
```

How to achieve polymorphic object copying?


BlinkDecorator
BlinkDecorator(Shape pShape)
aShape
1
Drawing Editor
«interface»
Shape
void ChangeColor(Color pColor)
void Move(int pX, int pY)
CompositeShape
void add(Shape pShape)
aElements
1
aShape
MemorizingColorDecorator
MemorizingColorDecorator(Shape pShape)
Shape clone()
Line
Circle
Rectangle

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public List<Shape> getShapess()
{
    // return a copy of aShapes;
    List<Shape> shapesCopy = new ArrayList<>();
    for(Shape sp:aShapes)
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            shapesCopy.add(new Line(sp));
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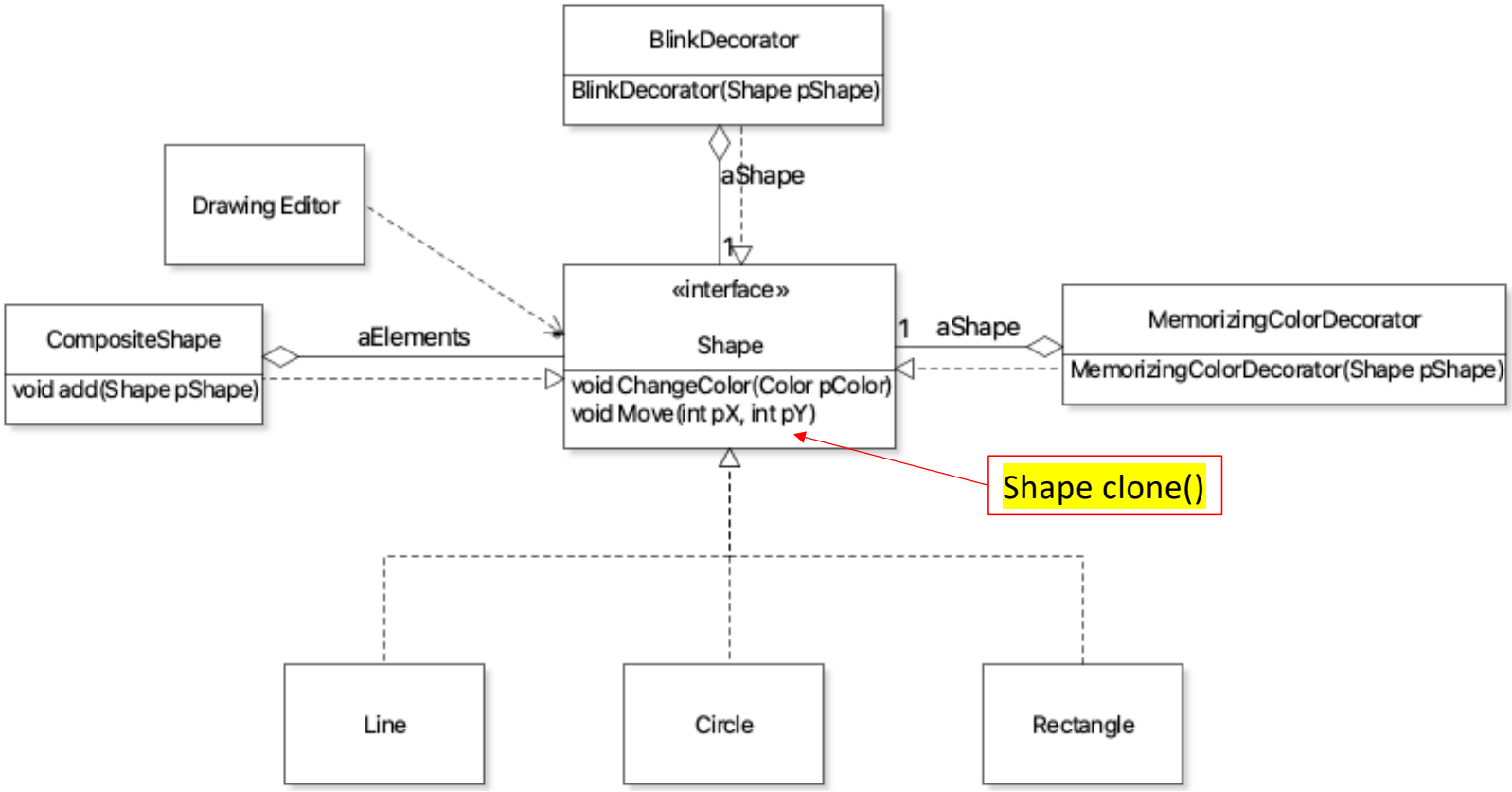
        else if (sp instanceof Circle)
        {
            shapesCopy.add(new Circle(sp));
        }
        else if (sp instanceof
        CompositeShape)
        {
            ……
        }
        ……
    }
    return shapesCopy;
}
```

```java
public List<Shape> getShapess()
{
    // return a copy of aShapes;
    List<Shape> shapesCopy = new ArrayList<>();
    for(Shape sp:aShapes)
    {

            shapesCopy.add(sp.clone());



    }
    return shapesCopy;
}
```

```java
/**
 * Aggregate a collection of shapes.
 * The client can get shapes and
 * add new shape on demand
 *
 */
public class ShapeManager
{
    private final List<Shape> aShapes = new ArrayList<>();

    public List<Shape> getShapes()
    {
        // return a copy of aShapes;
    }

    public void addShape(Shape pShape)
    {
        aShapes.add(pShape.clone());
    }
}
```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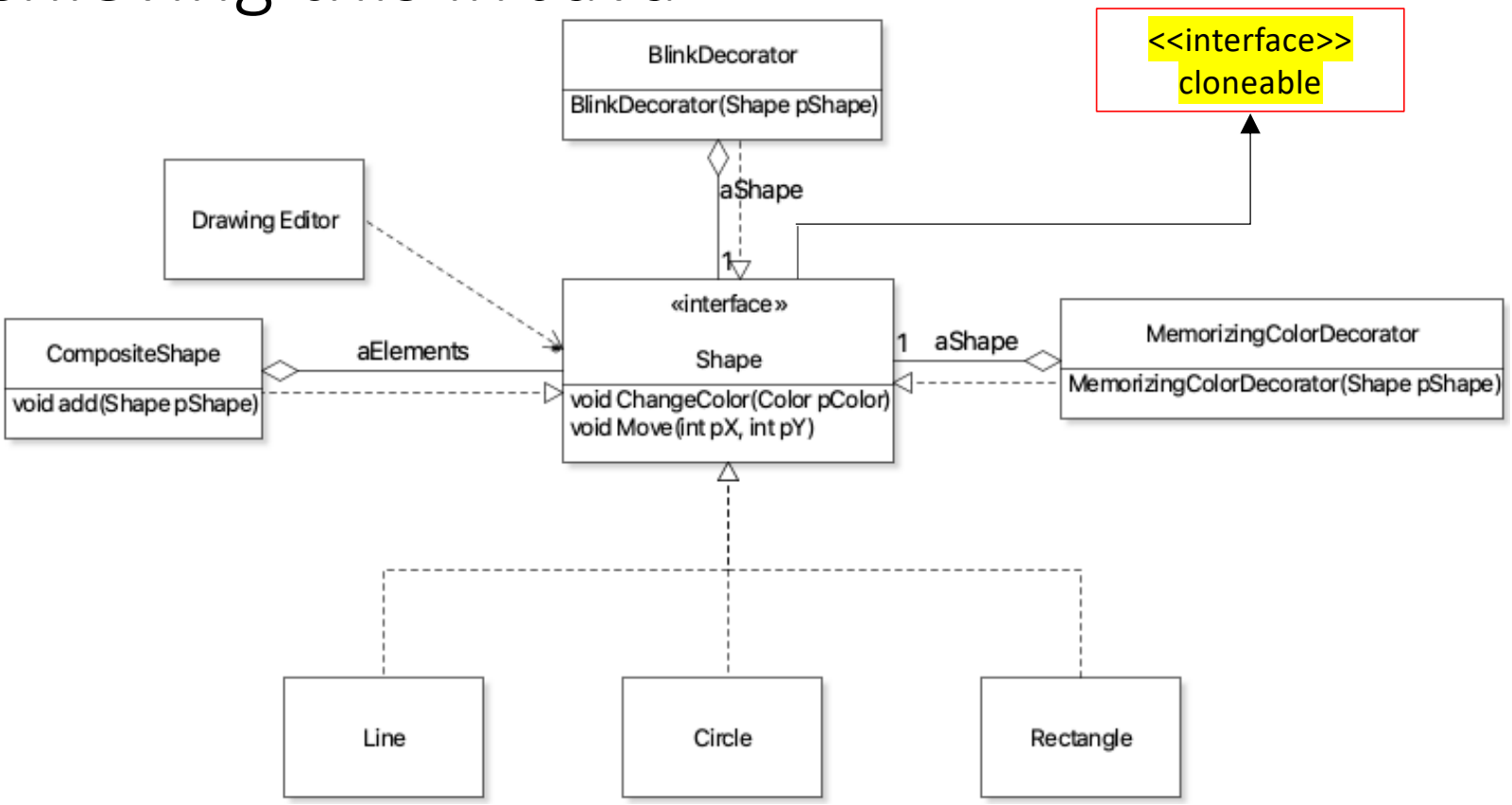
Achieving this in Java



Implements Cloneable

- java.lang.Cloneable

this interface does *not* contain the clone method.

implement this interface should override Object.clone with a public method.

A class implements the Cloneable interface to indicate to the Object.clone() method that it is legal for that method to make a field-for-field copy of instances of that class.

Invoking Object's clone method on an instance that does not implement the Cloneable interface results in the exception CloneNotSupportedException being thrown.

Override Object.clone()

protected Object clone()
throws CloneNotSupportedException

Creates and returns a copy of this object.

x.clone() != x

x.clone().getClass() == x.getClass()

x.clone().equals(x)

object should be obtained by calling super.clone

the object returned by this method should be independent of this object

```
public class CompositeShape implements Shape
{
    private List<Shape> aElements = new ArrayList<>();

    @Override
    public CompositeShape clone()
    {
        try
        {
            CompositeShape clone = (CompositeShape) super.clone();
            clone.aElements = new ArrayList< Shape>();
            for (Shape sp:aElements)
            {
                clone.aElements.add(sp.clone());
            }
            return clone;
        }
        catch (CloneNotSupportedException e)
        {
            assert false;
            return null;
        }
    }
}
```

Making a shallow copy

```java
/**
 * Aggregate a collection of shapes.
 * The client can get shapes and
 * add new shape on demand
 *
 */
public class ShapeManager
{
    private final List<Shape> aShapes = new ArrayList<>();
                                        private Shape aPrototype;

    public List<Shape> getShapes()
    {
        // return a copy of aShapes;
    }

    public void addShape(Shape pShape)
    {
        // add a copy of pShape;
    }
}
```

```java
/**
 * Aggregate a collection of shapes.
 * The client can get shapes and
 * add new shape on demand
 *
 */
public class ShapeManager
{
    private final List<Shape> aShapes = new ArrayList<>();
                                        private Shape aPrototype;

    public List<Shape> getShapes()
    {
        // return a copy of aShapes;
    }

    public void setProptypeShape(Shape pShape)
    {
        aPrototype = pShape.clone();
    }
}    public void addCardSource()
     {
         aCardSources.add(aPrototype.clone());
     }
```

Prototype

- Intent
  - Specify the kinds of objects to create using a prototypical instance, and create new objects by copying this prototype.
- Participants
  - Prototype

    declares an interface for cloning itself.
  - Product (Concrete Prototype)

    implements an operation for cloning itself.
  - Client

    creates a new object by asking a prototype to clone itself.

What are the benefits and drawbacks of using Prototype Pattern?

- Please fill in the survey

native