Structural Patterns
These design patterns concern class and object composition. Concept of inheritance is used to compose interfaces and define ways to compose objects to obtain new functionalities.

Adapter Pattern:

Adapter pattern works as a bridge between two incompatible interfaces

This pattern involves a single class which is responsible to join functionalities of independent or incompatible interfaces. A real life example could be a case of card reader which acts as an adapter between memory card and a laptop. You plugin the memory card into card reader and card reader into the laptop so that memory card can be read via laptop.

We are demonstrating use of Adapter pattern via following example in which an audio player device can play mp3 files only and wants to use an advanced audio player capable of playing vlc and mp4 files.

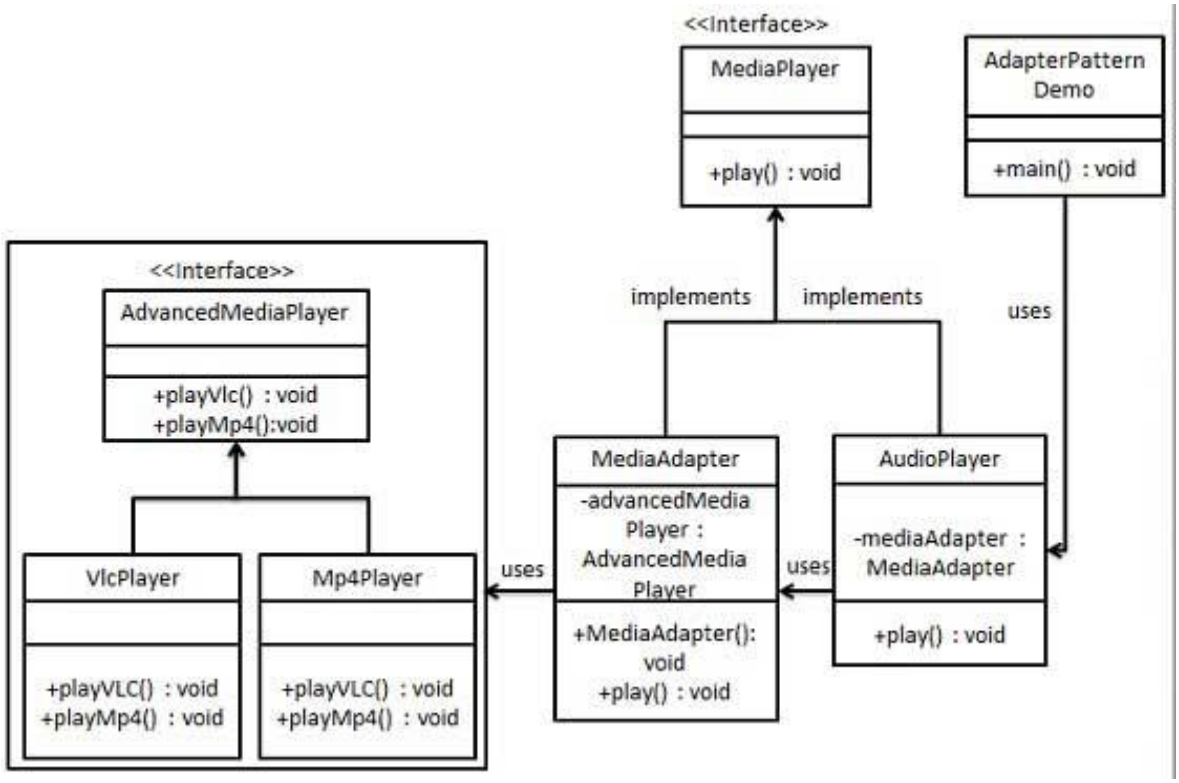
Implementation

We have a *MediaPlayer* interface and a concrete class *AudioPlayer* implementing the *MediaPlayer* interface. *AudioPlayer* can play mp3 format audio files by default.

We are having another interface *AdvancedMediaPlayer* and concrete classes implementing the *AdvancedMediaPlayer* interface. These classes can play vlc and mp4 format files.

We want to make *AudioPlayer* to play other formats as well. To attain this, we have created an adapter class *MediaAdapter* which implements the *MediaPlayer* interface and uses *AdvancedMediaPlayer* objects to play the required format.

AudioPlayer uses the adapter class *MediaAdapter* passing it the desired audio type without knowing the actual class which can play the desired format. *AdapterPatternDemo*, our demo class will use *AudioPlayer* class to play various formats.



Step 1

Create interfaces for Media Player and Advanced Media Player.

MediaPlayer.java

```
public interface MediaPlayer {
   public void play(String audioType, String fileName);
}
```

AdvancedMediaPlayer.java

```
public interface AdvancedMediaPlayer {
   public void playVlc(String fileName);
   public void playMp4(String fileName);
}
```

Step 2

Create concrete classes implementing the *AdvancedMediaPlayer* interface.

VlcPlayer.java

```
public class VlcPlayer implements AdvancedMediaPlayer{
   @Override
   public void playVlc(String fileName) {
      System.out.println("Playing vlc file. Name: "+ fileName);
   }

   @Override
   public void playMp4(String fileName) {
      //do nothing
   }
}
```

Mp4Player.java

```
public class Mp4Player implements AdvancedMediaPlayer{

   @Override
   public void playVlc(String fileName) {
      //do nothing
   }

   @Override
   public void playMp4(String fileName) {
      System.out.println("Playing mp4 file. Name: "+ fileName);
   }
}
```

Step 3

Create adapter class implementing the *MediaPlayer* interface.

MediaAdapter.java

```
public class MediaAdapter implements MediaPlayer {

   AdvancedMediaPlayer advancedMusicPlayer;

   public MediaAdapter(String audioType){

      if(audioType.equalsIgnoreCase("vlc") ){
         advancedMusicPlayer = new VlcPlayer();

      }else if (audioType.equalsIgnoreCase("mp4")){
         advancedMusicPlayer = new Mp4Player();
      }
   }
```

```
@Override
   public void play(String audioType, String fileName) {

      if(audioType.equalsIgnoreCase("vlc")){
         advancedMusicPlayer.playVlc(fileName);
      }
      else if(audioType.equalsIgnoreCase("mp4")){
         advancedMusicPlayer.playMp4(fileName);
      }
   }
}
```

Step 4

Create concrete class implementing the *MediaPlayer* interface.

AudioPlayer.java

```
public class AudioPlayer implements MediaPlayer {
   MediaAdapter mediaAdapter;

   @Override
   public void play(String audioType, String fileName) {

      //inbuilt support to play mp3 music files
      if(audioType.equalsIgnoreCase("mp3")){
         System.out.println("Playing mp3 file. Name: " + fileName);
      }

      //mediaAdapter is providing support to play other file formats
      else if(audioType.equalsIgnoreCase("vlc") ||
audioType.equalsIgnoreCase("mp4")){
         mediaAdapter = new MediaAdapter(audioType);
         mediaAdapter.play(audioType, fileName);
      }

      else{
         System.out.println("Invalid media. " + audioType + " format not
supported");
      }
   }
}
```

Step 5

Use the AudioPlayer to play different types of audio formats.

AdapterPatternDemo.java

```
public class AdapterPatternDemo {
   public static void main(String[] args) {
      AudioPlayer audioPlayer = new AudioPlayer();

      audioPlayer.play("mp3", "beyond the horizon.mp3");
      audioPlayer.play("mp4", "alone.mp4");
      audioPlayer.play("vlc", "far far away.vlc");
      audioPlayer.play("avi", "mind me.avi");
   }
}
```

Step 6

Verify the output.

```
Playing mp3 file. Name: beyond the horizon.mp3
Playing mp4 file. Name: alone.mp4
Playing vlc file. Name: far far away.vlc
Invalid media. avi format not supported
```

Bridge Pattern:

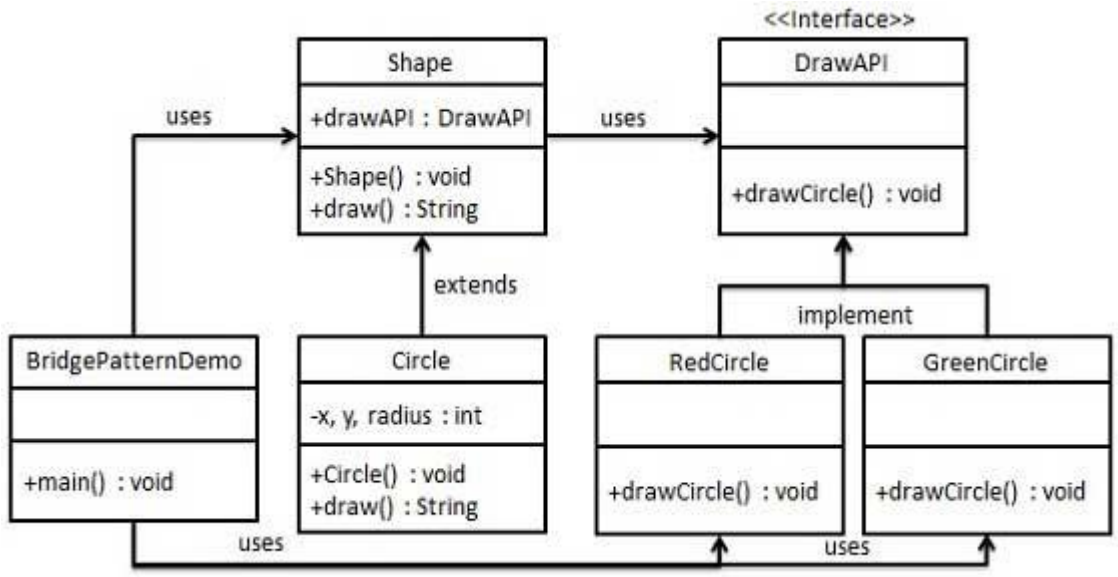
Bridge is used when we need to decouple an abstraction from its implementation so that the two can vary independently. This type of design pattern comes under structural pattern as this pattern decouples implementation class and abstract class by providing a bridge structure between them.

This pattern involves an interface which acts as a bridge which makes the functionality of concrete classes independent from interface implementer classes. Both types of classes can be altered structurally without affecting each other.

We are demonstrating use of Bridge pattern via following example in which a circle can be drawn in different colors using same abstract class method but different bridge implementer classes.

Implementation

We have a *DrawAPI* interface which is acting as a bridge implementer and concrete classes *RedCircle*, *GreenCircle* implementing the *DrawAPI* interface. *Shape* is an abstract class and will use object of *DrawAPI*. *BridgePatternDemo*, our demo class will use *Shape* class to draw different colored circle.



Step 1

Create bridge implementer interface.

DrawAPI.java

```
public interface DrawAPI {
   public void drawCircle(int radius, int x, int y);
}
```

Step 2

Create concrete bridge implementer classes implementing the *DrawAPI* interface.

RedCircle.java

```
public class RedCircle implements DrawAPI {
   @Override
   public void drawCircle(int radius, int x, int y) {
      System.out.println("Drawing Circle[ color: red, radius: " + radius +
", x: " + x + ", " + y + "]");
   }
}
```

GreenCircle.java

```
public class GreenCircle implements DrawAPI {
   @Override
   public void drawCircle(int radius, int x, int y) {
      System.out.println("Drawing Circle[ color: green, radius: " + radius
+ ", x: " + x + ", " + y + "]");
   }
}
```

Step 3

Create an abstract class *Shape* using the *DrawAPI* interface.

Shape.java

```
public abstract class Shape {
   protected DrawAPI drawAPI;

   protected Shape(DrawAPI drawAPI){
      this.drawAPI = drawAPI;
   }
   public abstract void draw();
}
```

Step 4

Create concrete class implementing the *Shape* interface.

Circle.java

```
public class Circle extends Shape {
   private int x, y, radius;

   public Circle(int x, int y, int radius, DrawAPI drawAPI) {
      super(drawAPI);
      this.x = x;
      this.y = y;
      this.radius = radius;
   }

   public void draw() {
      drawAPI.drawCircle(radius,x,y);
   }
}
```

Step 5

Use the *Shape* and *DrawAPI* classes to draw different colored circles.

BridgePatternDemo.java

```
public class BridgePatternDemo {
   public static void main(String[] args) {
      Shape redCircle = new Circle(100,100, 10, new RedCircle());
      Shape greenCircle = new Circle(100,100, 10, new GreenCircle());

      redCircle.draw();
      greenCircle.draw();
   }
}
```

Step 6

Verify the output.

```
Drawing Circle[ color: red, radius: 10, x: 100, 100]
Drawing Circle[  color: green, radius: 10, x: 100, 100]
```