GoF (Gang of Four) Design Patterns

for

Soccer Live

Version: 1.0

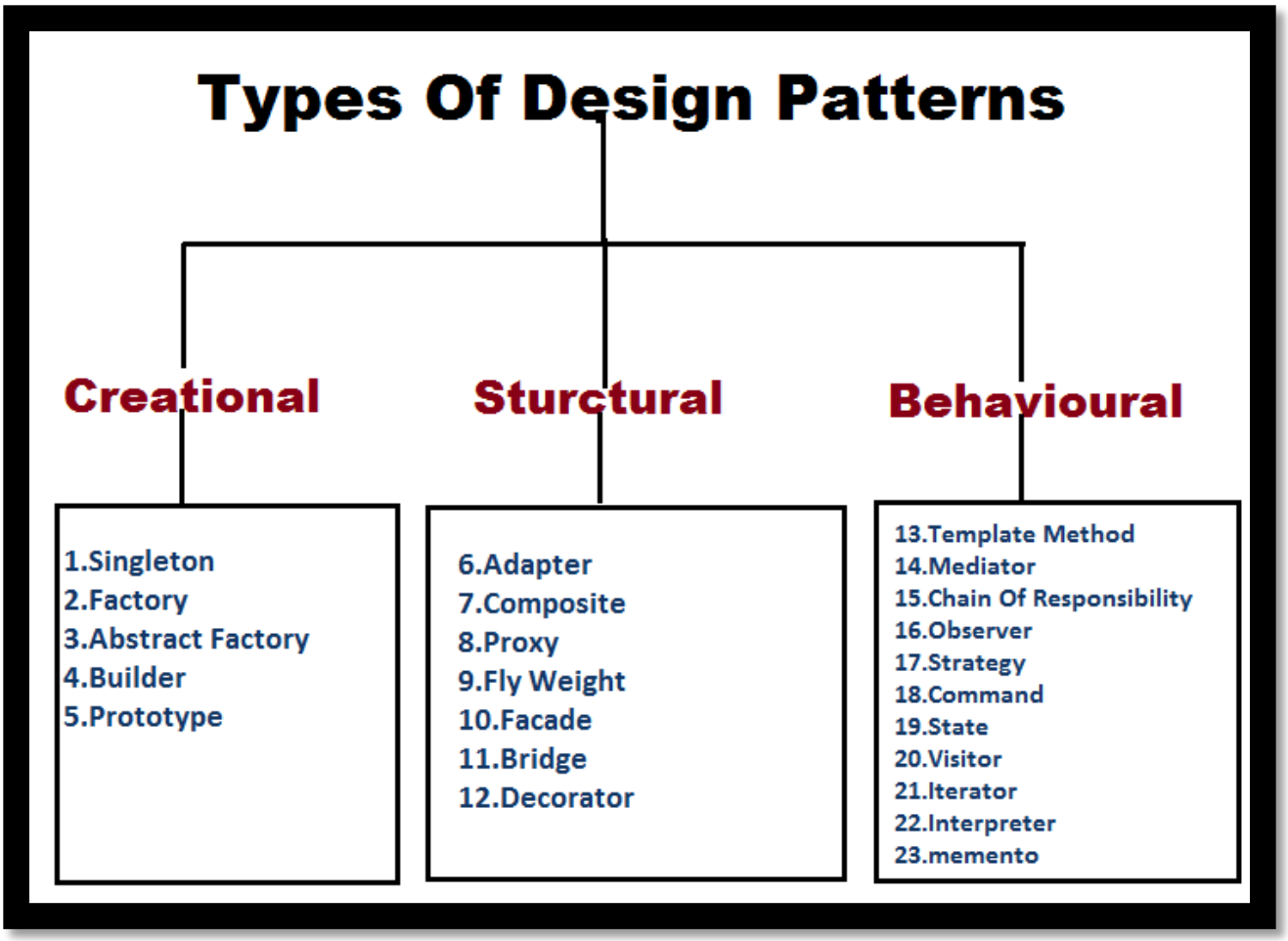
Prepared by: Usman Awan | 22F-3378

Organization: FAST NUCES CFD

Date: 2 nd October, 2

Contents

1. Creational Pattern: Singleton Pattern 3
Purpose 3
Steps For Making this Design Pattern: 3
Java Code 3
VS Code Interface: 5
Output: 5
2. Structural Pattern: Adapter Pattern 6
Purpose 6
Steps For Making this Design Pattern: 6
Java Code 6
VS CODE Interface 8
Output: 8
3. Behavioral Pattern: Observer Pattern 9
Purpose 9
Steps For Making this Design Pattern: 9
Java Code 9
VS Code Interface: 12
Output: 12
Table of Three GoF Design Patterns 12



1. Creational Pattern: Singleton Pattern

Purpose

The Singleton pattern is used to ensure that the **Streaming Engine** is a single instance throughout the application. This guarantees consistent behavior and avoids issues like resource conflicts when multiple streams are initiated. The StreamingEngine class will implement this pattern to provide a global point of access to the instance.

Steps For Making this Design Pattern:

1. Create a StreamingEngine class.
2. Implement the Singleton pattern to ensure only one instance exists.
3. Provide a global point of access to the instance.

Java Code

```
// SingletonPattern.java
```

```
public class SingletonPattern {
    public static void main(String[] args) {
        // Fetching the single instance of StreamingEngine
        StreamingEngine engine = StreamingEngine.getInstance();
        engine.startStream("Team A vs Team B");
    }
}

class StreamingEngine {
    // Static variable to hold the single instance
    private static StreamingEngine instance;

    // Private constructor to prevent external instantiation
    private StreamingEngine() {
        System.out.println("Streaming Engine Initialized");
    }

    // Public static method to provide access to the single instance
    public static synchronized StreamingEngine getInstance() {
        if (instance == null) {
            instance = new StreamingEngine();
        }
        return instance;
    }

    // Example method to simulate streaming
```

```
    public void startStream(String match) {

        System.out.println("Streaming match: " + match);

    }

}
```

VS Code Interface:

SingletonPattern.java | StreamingEngine.class | SingletonPattern.class | StreamingEngine.class

SingletonPattern.java > Language Support for Java(TM) by Red Hat > StreamingEngine > startStream(String)

```java
// SingletonPattern.java
public class SingletonPattern {
    Run main | Debug main | Run | Debug
    public static void main(String[] args) {
        // Fetching the single instance of StreamingEngine
        StreamingEngine engine = StreamingEngine.getInstance();
        engine.startStream(match:"Team A vs Team B");
    }
}

class StreamingEngine {
    // Static variable to hold the single instance
    private static StreamingEngine instance;

    // Private constructor to prevent external instantiation
    private StreamingEngine() {
        System.out.println(x:"Streaming Engine Initialized");
    }

    // Public static method to provide access to the single instance
    public static synchronized StreamingEngine getInstance() {
        if (instance == null) {
            instance = new StreamingEngine();
        }
        return instance;
    }

    // Example method to simulate streaming
    public void startStream(String match) {
        System.out.println("Streaming match: " + match);
    }
}
```

Output:

PROBLEMS | OUTPUT | DEBUG CONSOLE | TERMINAL | PORTS | COMMENTS

```
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Singleton> javac SingletonPattern.java
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Singleton> java SingletonPattern
Streaming Engine Initialized
Streaming match: Team A vs Team B
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Singleton>
```

2. Structural Pattern: Adapter Pattern

Purpose

The Adapter pattern is used to enable compatibility with multiple video codecs and streaming formats. The MediaAdapter class acts as a bridge between the Streaming Engine and specific video players (e.g., for MP4 and MKV formats), ensuring smooth playback across different formats.

Steps For Making this Design Pattern:

1. Define a MediaPlayer interface for playback functionality.
2. Implement a VideoPlayer class for a specific codec.
3. Create an Adapter class to translate requests from the StreamingEngine to VideoPlayer.

Java Code

```
// AdapterPattern.java

public class AdapterPattern {

    public static void main(String[] args) {

        MediaPlayer adapter = new MediaAdapter();

        adapter.play("MP4", "match.mp4");

        adapter.play("MKV", "highlight.mkv");

        adapter.play("AVI", "unsupported.avi");

    }

}


interface MediaPlayer {

    void play(String videoFormat, String videoFile);

}


class VideoPlayer {

    public void playMP4(String file) {
```

```
        System.out.println("Playing MP4 file: " + file);
    }

    public void playMKV(String file) {
        System.out.println("Playing MKV file: " + file);
    }
}

class MediaAdapter implements MediaPlayer {
    private VideoPlayer videoPlayer;

    public MediaAdapter() {
        this.videoPlayer = new VideoPlayer();
    }

    @Override
    public void play(String videoFormat, String videoFile) {
        if (videoFormat.equalsIgnoreCase("MP4")) {
            videoPlayer.playMP4(videoFile);
        } else if (videoFormat.equalsIgnoreCase("MKV")) {
            videoPlayer.playMKV(videoFile);
        } else {
            System.out.println("Unsupported format: " + videoFormat);
        }
    }
}
```

VS CODE Interface

AdapterPattern.java 1 | AdapterPattern.class | MediaAdapter.class | MediaPlayer.class | VideoPlayer.class

AdapterPattern.java > Language Support for Java(TM) by Red Hat > MediaPlayer

```java
// AdapterPattern.java
public class AdapterPattern {
    Run main | Debug main | Run | Debug
    public static void main(String[] args) {
        MediaPlayer adapter = new MediaAdapter();
        adapter.play(videoFormat:"MP4", videoFile:"match.mp4");
        adapter.play(videoFormat:"MKV", videoFile:"highlight.mkv");
        adapter.play(videoFormat:"AVI", videoFile:"unsupported.avi");
    }
}

interface MediaPlayer {
    void play(String videoFormat, String videoFile);
}

class VideoPlayer {
    public void playMP4(String file) {
        System.out.println("Playing MP4 file: " + file);
    }

    public void playMKV(String file) {
        System.out.println("Playing MKV file: " + file);
    }
}

class MediaAdapter implements MediaPlayer {
    private VideoPlayer videoPlayer;

    public MediaAdapter() {
        this.videoPlayer = new VideoPlayer();
    }

    @Override
    public void play(String videoFormat, String videoFile) {
        if (videoFormat.equalsIgnoreCase(anotherString:"MP4")) {
            videoPlayer.playMP4(videoFile);
        } else if (videoFormat.equalsIgnoreCase(anotherString:"MKV")) {
            videoPlayer.playMKV(videoFile);
        } else {
            System.out.println("Unsupported format: " + videoFormat);
        }
    }
}
```

Output:

PROBLEMS 1 | OUTPUT | DEBUG CONSOLE | TERMINAL | PORTS | COMMENTS | powershell

```
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Adapter> javac AdapterPattern.java
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Adapter> java AdapterPattern
Playing MP4 file: match.mp4
Playing MKV file: highlight.mkv
Unsupported format: AVI
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Adapter>
```

3. Behavioral Pattern: Observer Pattern

Purpose

The Observer pattern is used to notify users in real-time about **match updates** and **breaking news**. The MatchUpdateNotifier class acts as the **Subject** that maintains a list of observers, while each UserDevice represents a concrete **Observer**.

Steps For Making this Design Pattern:

1. Create a Subject class that maintains a list of observers.
2. Define an Observer interface.
3. Implement concrete observer classes (e.g., UserDevice).
4. Notify observers when updates occur.

Java Code

```
// ObserverPattern.java

import java.util.ArrayList;

import java.util.List;


public class ObserverPattern {

    public static void main(String[] args) {

        MatchUpdateNotifier notifier = new MatchUpdateNotifier();


        // Create observers

        UserDevice device1 = new UserDevice("Phone");

        UserDevice device2 = new UserDevice("Tablet");


        // Register observers

        notifier.addObserver(device1);

        notifier.addObserver(device2);
```

```
        // Notify observers
        notifier.notifyObservers("Goal scored by Team A!");
    }
}

interface Observer {
    void update(String message);
}

class UserDevice implements Observer {
    private String deviceName;

    public UserDevice(String deviceName) {
        this.deviceName = deviceName;
    }

    @Override
    public void update(String message) {
        System.out.println(deviceName + " received update: " + message);
    }
}

class MatchUpdateNotifier {
    private List<Observer> observers = new ArrayList<>();

    // Add observer
```

```
    public void addObserver(Observer observer) {
        observers.add(observer);
    }

    // Remove observer
    public void removeObserver(Observer observer) {
        observers.remove(observer);
    }

    // Notify all observers
    public void notifyObservers(String message) {
        for (Observer observer : observers) {
            observer.update(message);
        }
    }
}
```

VS Code Interface:

ObserverPattern.java 2 | MatchUpdateNotifier.class | Observer.class | ObserverPattern.class | UserDevice.class

ObserverPattern.java > Language Support for Java(TM) by Red Hat > UserDevice > update(String)

```java
interface Observer {
    void update(String message);
}

class UserDevice implements Observer {
    private String deviceName;

    public UserDevice(String deviceName) {
        this.deviceName = deviceName;
    }

    @Override
    public void update(String message) {
        System.out.println(deviceName + " received update: " + message);
    }
}

class MatchUpdateNotifier {
    private List<Observer> observers = new ArrayList<>();

    // Add observer
    public void addObserver(Observer observer) {
        observers.add(observer);
    }

    // Remove observer
    public void removeObserver(Observer observer) {
        observers.remove(observer);
    }

    // Notify all observers
    public void notifyObservers(String message) {
        for (Observer observer : observers) {
            observer.update(message);
        }
    }
}
```

Output:

PROBLEMS 2 | OUTPUT | DEBUG CONSOLE | TERMINAL | PORTS | COMMENTS | powershell

```
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Observer> javac ObserverPattern.java
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Observer> java ObserverPattern
Phone received update: Goal scored by Team A!
Tablet received update: Goal scored by Team A!
PS D:\FAST SEMESTERS\SEMESTER 5\SDA\Project\Deliverable 3_ SDA\GoF Patterns\Observer>
```

Table of Three GoF Design Patterns

Pattern	Purpose	Implementation
Singleton	Ensure a single instance of the **Streaming Engine**.	Implemented with private constructor and a static method to return the single instance.
Adapter	Support multiple video codecs and formats for streaming.	An adapter bridges the gap between the **Streaming Engine** and video playback using the MediaAdapter class.

Observer	Notify users of match updates and breaking news in real-time.	The MatchUpdateNotifier class manages observers, and updates are pushed to registered UserDevice objects.