CODE > JAVA

Android Design Patterns: The Observer Pattern

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Java | Android SDK | Mobile Development | Android | Design Patterns | Programming Fundamentals

What Is the Observer Pattern?

The Observer Pattern is a software design pattern that establishes a one-to-many dependency between objects. Anytime the state of one of the objects (the "subject" or "observable") changes, all of the other objects ("observers") that depend on it are notified.

Let's use the example of users that have subscribed to receive offers from Envato Market via email. The users in this case are observers. Anytime there is an offer from Envato Market, they get notified about it via email. Each user can then either buy into the offer or decide that they might not be really interested in it at that moment. A user (an observer) can also subscribe to receive offers from another e-commerce marketplace if they want and might later completely unsubscribe from receiving offers from any of them.

This pattern is very similar to the Publish-Subscribe pattern. The subject or observable publishes out a notification to the dependent observers without even knowing how many observers have subscribed to it, or who they are—the observable only knows that they should implement an interface (we'll get to that shortly), without worrying about what action the observers might perform.

Benefits of the Observer Pattern

- The subject knows little about its observers. The only thing it knows is that the observers implement or agree to a certain contract or interface.
- Subjects can be reused without involving their observers, and the same goes for observers too.
- No modification is done to the subject to accommodate a new observer. The new observer just needs to

implement an interface that the subject is aware of and then register to the subject.
- An observer can be registered to more than one subject it's registered to.

All these benefits give you loose coupling between modules in your code, which enables you to build a flexible design for your application. In the rest of this post, we'll look at how to create our own Observer pattern implementation, and we'll also use the built-in Java Observer/Observable API as well as looking into third-party libraries that can offer such functionality.

Building Our Own Observer Pattern

1. Create the Subject Interface

We start by defining an interface that subjects (observables) will implement.

```
public interface Subject {
    void registerObserver(RepositoryObserver repositoryObserver);
    void removeObserver(RepositoryObserver repositoryObserver);
    void notifyObservers();
}
```

In the code above, we created a Java Interface with three methods. The first method `registerObserver()`, as it says, will register an observer of type `RepositoryObserver` (we'll create that interface shortly) to the subject. `removeObserver()` will be called to remove an observer that wants to stop getting notifications from the subject, and finally, `notifyObserver()` will send a broadcast to all observers whenever there is a change. Now, let's create a concrete subject class that will implement the subject interface we have created:

```
import android.os.Handler;
import java.util.ArrayList;

public class UserDataRepository implements Subject {
    private String mFullName;
    private int mAge;
    private static UserDataRepository INSTANCE = null;

    private ArrayList<RepositoryObserver> mObservers;

    private UserDataRepository() {
        mObservers = new ArrayList<>();
        getNewDataFromRemote();
    }

    // Simulate network
    private void getNewDataFromRemote() {
        final Handler handler = new Handler();
        handler.postDelayed(new Runnable() {
            @Override
            public void run() {
                setUserData("Chike Mgbemena", 101);
            }
        }, 10000);
    }

    // Creates a Singleton of the class
    public static UserDataRepository getInstance() {
        if(INSTANCE == null) {
            INSTANCE = new UserDataRepository();
        }
        return INSTANCE;
    }

    @Override
    public void registerObserver(RepositoryObserver repositoryObserver) {
        if(!mObservers.contains(repositoryObserver)) {
            mObservers.add(repositoryObserver);
        }
    }

    @Override
    public void removeObserver(RepositoryObserver repositoryObserver) {
        if(mObservers.contains(repositoryObserver)) {
            mObservers.remove(repositoryObserver);
```

```
            mObservers.remove(repositoryObserver);
        }
    }

    @Override
    public void notifyObservers() {
        for (RepositoryObserver observer: mObservers) {
            observer.onUserDataChanged(mFullName, mAge);
        }
    }

    public void setUserData(String fullName, int age) {
        mFullName = fullName;
        mAge = age;
        notifyObservers();
    }
}
```

The class above implements the `Subject` interface. We have an `ArrayList` that holds the observers and then creates it in the private constructor. An observer registers by being added to the `ArrayList` and likewise, unregisters by being removed from the `ArrayList`.

Note that we are simulating a network request to retrieve the new data. Once the `setUserData()` method is called and given the new value for the full name and age, we call the `notifyObservers()` method which, as it says, notifies or sends a broadcast to all registered observers about the new data change. The new values for the full name and age are also passed along. This subject can have multiple observers but, in this tutorial, we'll create just one observer. But first, let's create the observer interface.

2. Create the Observer Interface

```
public interface RepositoryObserver {
    void onUserDataChanged(String fullname, int age);
}
```

In the code above, we created the observer interface which concrete observers should implement. This allows our code to be more flexible because we are coding to an interface instead of a concrete implementation. A concrete `Subject` class does not need to be aware of the many concrete observers it may have; all it knows about them is that they implement the `RepositoryObserver` interface.

Let's now create a concrete class that implements this interface.

```
import android.os.Bundle;
import android.support.v7.app.AppCompatActivity;
import android.widget.TextView;

public class UserProfileActivity extends AppCompatActivity implements RepositoryObserver {
    private Subject mUserDataRepository;
    private TextView mTextViewUserFullName;
    private TextView mTextViewUserAge;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_user_profile);

        mTextViewUserAge = (TextView) findViewById(R.id.tv_age);
        mTextViewUserFullName = (TextView) findViewById(R.id.tv_fullname);

        mUserDataRepository = UserDataRepository.getInstance();
        mUserDataRepository.registerObserver(this);
    }

    @Override
    public void onUserDataChanged(String fullname, int age) {
        mTextViewUserFullName.setText(fullname);
        mTextViewUserAge.setText(age);
    }

    @Override
    protected void onDestroy() {
        super.onDestroy();
        mUserDataRepository.removeObserver(this);
```

```
        mUserDataRepository.removeObserver(this);
    }
}
```

The first thing to notice in the code above is that `UserProfileActivity` implements the `RepositoryObserver` interface—so it must implement the method `onUserDataChanged()`. In the `onCreate()` method of the Activity, we got an instance of the `UserDataRepository` which we then initialized and finally registered this observer to.

In the `onDestroy()` method, we want to stop getting notifications, so we unregister from receiving notifications.

In the `onUserDataChanged()` method, we want to update the `TextView` widgets—`mTextViewUserFullName` and `mTextViewUserAge`—with the new set of data values.

Right now we just have one observer class, but it's possible and easy for us to create other classes that want to be observers of the `UserDataRepository` class. For example, we could easily have a `SettingsActivity` that wants to also be notified about the user data changes by becoming an observer.

Push and Pull Models

In the example above, we are using the push model of the observer pattern. In this model, the subject notifies the observers about the change by passing along the data that changed. But in the pull model, the subject will still notify the observers, but it does not actually pass the data that changed. The observers then pull the data they need once they receive the notification.

Utilising Java's Built-In Observer API

So far, we have created our own Observer pattern implementation, but Java has built-in Observer / Observable support in its API. In this section, we are going to use this. This API simplifies some of the implementation, as you'll see.

1. Create the Observable

Our `UserDataRepository`—which is our subject or observable—will now extend the `java.util.Observable` superclass to become an Observable. This is a class that wants to be observed by one or more observers.

```
import android.os.Handler;
import java.util.Observable;

public class UserDataRepository extends Observable {
    private String mFullName;
    private int mAge;
    private static UserDataRepository INSTANCE = null;

    private UserDataRepository() {
        getNewDataFromRemote();
    }

    // Returns a single instance of this class, creating it if necessary.
    public static UserDataRepository getInstance() {
        if(INSTANCE == null) {
            INSTANCE = new UserDataRepository();
        }
        return INSTANCE;
    }

    // Simulate network

    private void getNewDataFromRemote() {
        final Handler handler = new Handler();
        handler.postDelayed(new Runnable() {
            @Override
            public void run() {
                setUserData("Mgbemena Chike", 102);
            }
```

```
        }, 10000);
    }

    public void setUserData(String fullName, int age) {
        mFullName = fullName;
        mAge = age;
        setChanged();
        notifyObservers();
    }

    public String getFullName() {
        return mFullName;
    }

    public int getAge() {
        return mAge;
    }
}
```

Now that we have refactored our `UserDataRepository` class to use the Java Observable API, let's see what has changed compared to the previous version. The first thing to notice is that we are extending a super class (this means that this class can't extend any other class) and not implementing an interface as we did in the previous section.

We are no longer holding an `ArrayList` of observers; this is handled in the super class. Similarly, we don't have to worry about registration, removal, or notification of observers—`java.util.Observable` is handling all of those for us.

Another difference is that in this class we are employing a pull style. We alert the observers that a change has happened with `notifyObservers()`, but the observers will need to pull the data using the field getters we have defined in this class. If you want to use the push style instead, then you can use the method `notifyObservers(Object arg)` and pass the changed data to the observers in the object argument.

The `setChanged()` method of the super class sets a flag to true, indicating that the data has changed. Then you can call the `notifyObservers()` method. Be aware that if you don't call `setChanged()` before calling `notifyObsevers()`, the observers won't be notified. You can check the value of this flag by using the method `hasChanged()` and clear it back to false with `clearChanged()`. Now that we have our observable class created, let's see how to set up an observer also.

2. Create the Observer

Our `UserDataRepository` observable class needs a corresponding Observer to be useful, so let's refactor our `UserProfileActivity` to implement the `java.util.Observer` interface.

```
import android.os.Bundle;
import android.support.v7.app.AppCompatActivity;
import android.widget.TextView;
import com.chikeandroid.tutsplusobserverpattern.R;
import java.util.Observable;
import java.util.Observer;

public class UserProfileActivity extends AppCompatActivity implements Observer {
    private Observable mUserDataRepositoryObservable;
    private TextView mTextViewUserFullName;
    private TextView mTextViewUserAge;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_user_profile);

        mTextViewUserAge = (TextView) findViewById(R.id.tv_age);
        mTextViewUserFullName = (TextView) findViewById(R.id.tv_fullname);

        mUserDataRepositoryObservable = UserDataRepository.getInstance();
        mUserDataRepositoryObservable.addObserver(this);
    }

    @Override
    public void update(Observable observable, Object o) {
        if (observable instanceof UserDataRepository) {
            UserDataRepository userDataRepository = (UserDataRepository)observable;
```

```
            mTextViewUserAge.setText(String.valueOf(userDataRepository.getAge()));
            mTextViewUserFullName.setText(userDataRepository.getFullName());
        }
    }

    @Override
    protected void onDestroy() {
        super.onDestroy();
        mUserDataRepositoryObservable.deleteObserver(this);
    }
}
```

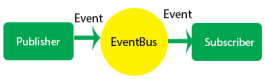
In the `onCreate()` method, we add this class as an observer to the `UserDataRepository` observable by using the `addObserver()` method in the `java.util.Observable` super class.

In the `update()` method which the observer must implement, we check if the `Observable` we receive as a parameter is an instance of our `UserDataRepository` (note that an observer can subscribe to different observables), and then we cast it to that instance and retrieve the values we want using the field getters. Then we use those values to update the view widgets.

When the activity is destroyed, we don't need to get any updates from the observable, so we'll just remove the activity from the observer list by calling the method `deleteObserver()`.

Libraries to Implement an Observer Pattern

If you don't want to build your own Observer pattern implementation from scratch or use the Java Observer API, you can use some free and open-source libraries that are available for Android such as Greenrobot's EventBus. To learn more about it, check out my tutorial here on Envato Tuts+.



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Conclusion

In this tutorial, you learned about the Observer pattern in Java: what is it, the benefits of using it, how to implement your own, using the Java Observer API, and also some third-party libraries for implementing this pattern.

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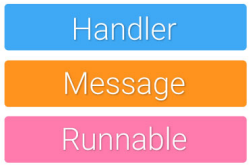

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Chike is a software developer, a technical writer, and a computer science graduate based in Lagos, Nigeria. He enjoys building software solutions, teaching programming technologies, learning new tricks, listening to music, and swimming.

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Boris Burtin • 4 months ago

I've used a customer Loader to make network requests in the background and notify the Activity when the request completes. What are the pros/cons of using your approach instead of a Loader?

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Mgbemena Chike Boris Burtin • 4 months ago

Hi Boris, the main objective of the write up is for the reader to understand what the Observer Pattern is all about. Your implementation, I think is using this pattern in some way. You can also use a Service, Alarm Manager, Job Scheduler , GCM Network Manager to perform background task(s) or job(s) (it all depends on your use case) and then send notifications on the status to observers.

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