Programming in Android

Session: 8

Services, Broadcast Receivers, and Intent Filters

Objectives

- Explain services
- Explain service lifecycle
- Describe broadcast receiver and its working
- Explain filters
- Explain intent matching and its rules
- Explain filters in manifest file and broadcast receivers

Introduction

- The main components that play an important role are:
  - Activities
  - Services
  - Content Providers
  - Broadcast receivers
- Services are executed in the background to perform long-running operations
- Broadcast receivers respond to announcements
- Intents are used for activating components

Services

- Services can perform background tasks without providing a user interface
- Service class creates application components that are specifically suited to handle functions that should run at the background
- Even if the user switches to another application, a service will continue to run in the background
- Service has higher priority when compared with an inactive activity

Implementing Services

- Services are declared in the application's manifest file
- To declare a service in the AndroidManifest.xml file, add a <service> element as a child of the <application> element as shown in the following Code Snippet:

```
<manifest ... >
...
<application ... >
<service android:name=".SampleService"/>
...
</application>
</manifest>
```

Creating a Service

- A component starts a service by invoking the startService() method
- It results in a call to the Service class onStartCommand() method
- To create a started service, following are the two classes from which the service class can extend from:
  - IntentService
  - Service
- IntentService class is implemented to avoid multi-threading
- It is started as a normal service, performs the tasks within a worker thread, and termi•nates when the task is performed

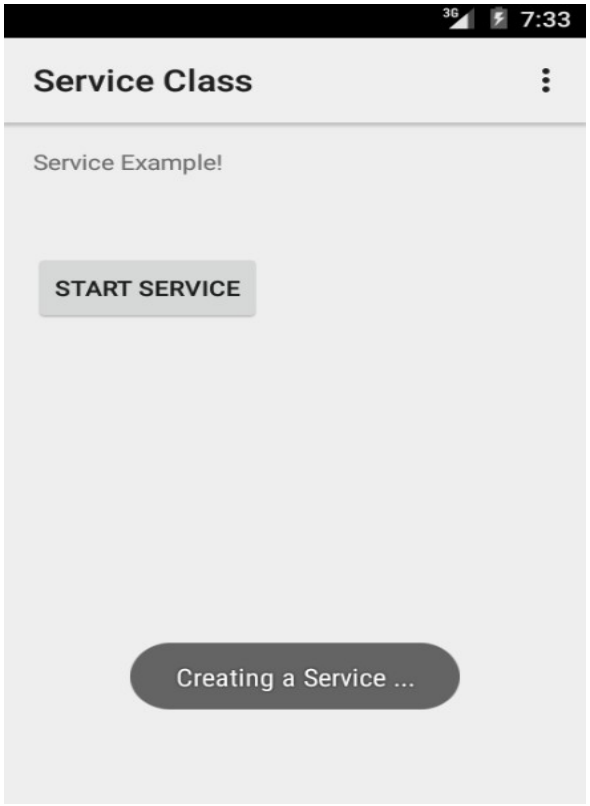
Extending IntentService

- Following Code Snippet demonstrates an example creating services by extending the IntentService class:

```
public class MyIntentService extends IntentService {
    public MyIntentService() {
        super("MyIntentService");
}

    @Override
    protected void onHandleIntent(Intent Intent) {
        …
    }
    @Override
    public void onCreate() {
        super.onCreate();
        …
    }
}
```

Services Example Application

- Using the code, an application for demonstrating Services is created as shown in the following figure:



- The application logic is as follows:

- Developer creates a Service by extending the Intent Service class
- The Service is started when the START SERVICE button is clicked
- The Service creates a Toast once it is started
- The Service creates another toast when an Intent is handled

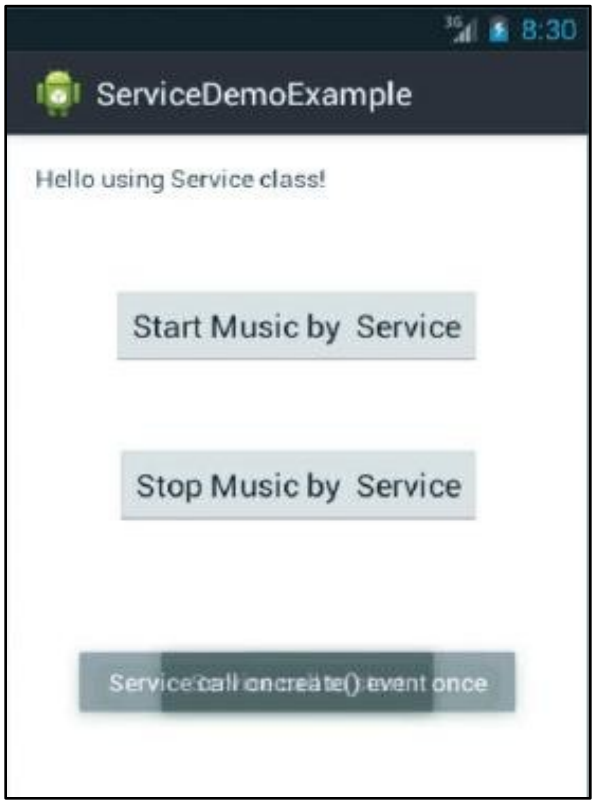
Extending Service Class

- Following Code Snippet demonstrates an example for creating a Service by extending the Service class:

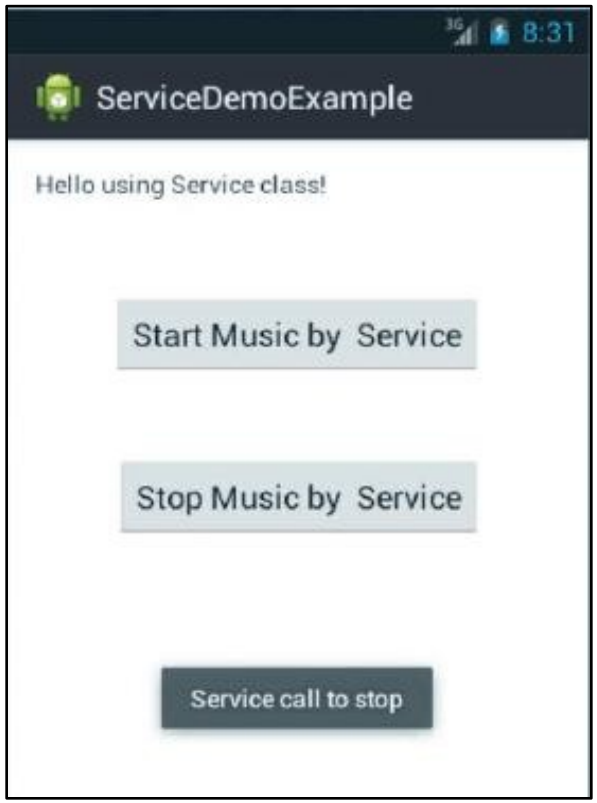
```
public class ServiceExample extends Service {

@Override
public IBinderonBind(Intent Intent) { …     }
         @Override
         public void onCreate() {
                  …
         }
         @Override
         public void onDestroy() {
                  …
         }
         @Override
         public void onStart(Intent Intent, int startid) {
                  …
         }
}
```

Example Application Extending Service 1-2

- Using the code, an application for demonstrating Services using the Service class is created as shown in the following figure:



- By clicking the 'Star Music by Service', the music starts to play as shown in the following figure:



Example Application Extending Service 2-2

- The application logic is as follows:

- Developer creates a Service by extending the Service class
- The Service is started when the Start Music by Service button is clicked
- Once started, the Service creates a MediaPlayer object to play an audio file
- The Service is stopped when the Stop Music by Service is clicked

Bound Services

- When components of an application bind to a service by calling bindService(), it is called a bound service
- Binding to a service helps in creating long-standing connection
- A service can be bound to:
  - Activity
  - Services
  - Content Providers
- To use a bound service, the onBind() callback method must be implemented
- It returns an IBinder that specifies the interface for communication with the service

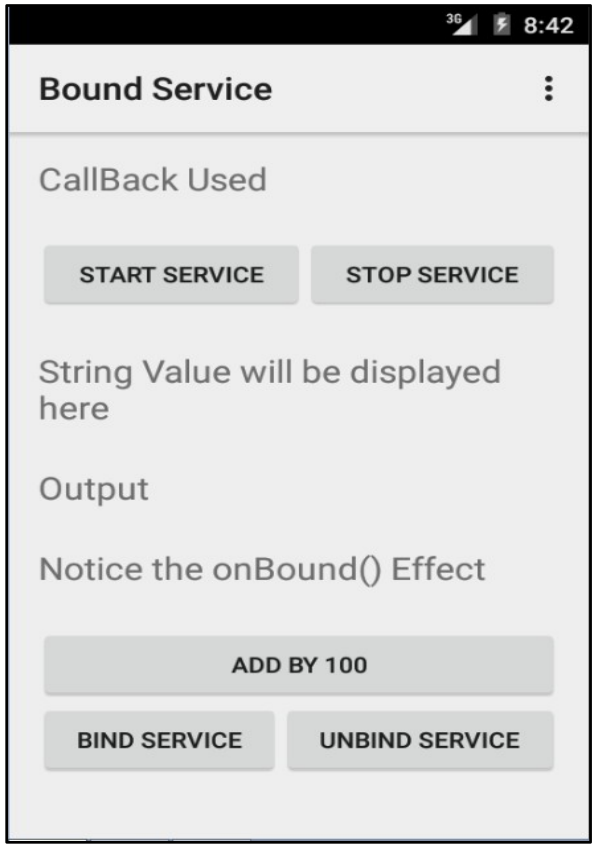
Bound Service Example

- Following Code Snippet demonstrates how to create a Bound Service:

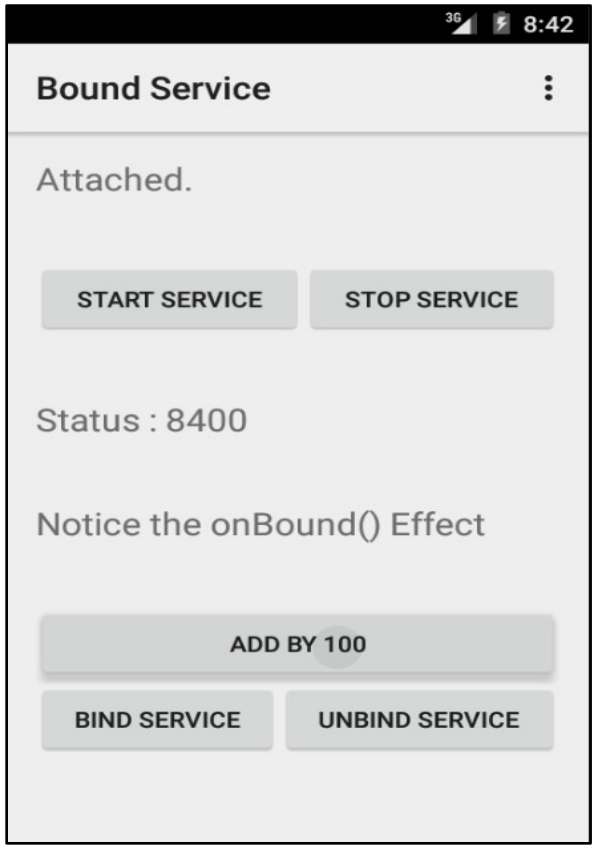
```
public class MyBoundService extends Service {
  …
final Messenger mMessenger = new Messenger (new IncomingHandler());
…
    @Override
    public IBinder onBind(Intent Intent) {
        return mMessenger.getBinder();
    }
…
}
```

Bound Services Example Application 1-2

- Using the explained code, an application for demonstrating Bound Services as shown in the following figure:

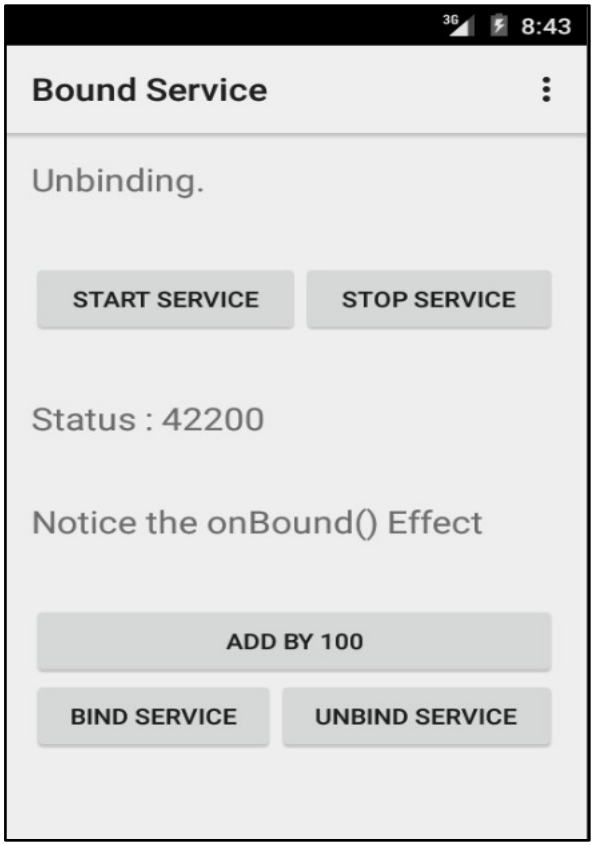


- Click START SERVICE, then click ADD BY 100 and finally, click BIND SERVICE to get the output as shown in the following figure:



Bound Services Example Application 2-2

- The STOP SERVICE button will stop the service and unbind the service. The output of stopping the service will be as shown in the following figure:



- The application logic is as follows:

- Developer creates a Service by extending the Service class
- The Service is started and stopped by clicking the Start and Stop buttons respectively
- Once the Bind Service button is clicked, the bindService() method is called
- When the UNBIND SERVICE button is clicked, the service is unbound
- Clicking on the ADD BY 100 button will send a message to the service which will increment the count by a value of 100

Broadcast Receivers and Intents

- Responsible for responding to system-wide broadcast announcements
- Intents are responsible for binding the different individual components to each other at runtime
- A broadcast receiver is an Android component which allows the application to register for system or application events
- Broadcast receivers do not display a user interface

Implementing Broadcast Receivers

- The steps to create a Broadcast Receiver are:
  - You have to create a subclass of Android's Broadcast Receiver
  - You have to implement the onReceive() method
- Android calls the onReceive() method on all registered broadcast receivers, when a matching broadcast Intent is identified
- The onReceive() method accepts following two arguments:
  - Context
  - Intent
- Following Code Snippet demonstrates how to create a Broadcast Receiver:

```
public class MyBroadcast extends BroadcastReceiver{
@Override
public void onReceive(Context context, Intent Intent) {
        …
}
```

Broadcast Receiver Example Application 1-2

- Using the code, an application for demonstrating Broadcast Receiver is as shown in the following figure:

- Enter 3 in the Edit box and the output will be as shown in the following figure:

Broadcast Receiver Example Application 2-2

- After three seconds the message will be displayed as shown in the following figure:

- The application logic is as follows:

- Developer creates an Activity with an EditText and a Button
- The user enters an interval to send the Broadcast Message
- When the timeout occurs, a Broadcast Message is sent
- A toast is displayed signifying the same

System Broadcast 1-2

- In the API, there are many classes that have specific broadcast events
- Following table lists some of the available events:

Event	Usage
Intent.ACTION_BATTERY_LOW	The battery level has dropped below a threshold
Intent.ACTION_BATTERY_OKAY	The battery level has increased again
Intent.ACTION_BOOT_COMPLETED	Android is up and running
Intent.ACTION_DEVICE_STORAGE_LOW	Storage space on the device is becoming less
Intent.ACTION_DEVICE_STORAGE_OK	The storage situation has improved again
Intent.ACTION_HEADSET_PLUG	A headset was plugged in or a previously plugged headset was removed
Intent.ACTION_LOCALE_CHANGED	The language of the device has been changed by the user

System Broadcast 2-2

Event	Usage
Intent.ACTION_MY_PACKAGE_REPLACED	The application has been updated
Intent.ACTION_PACKAGE_ADDED	A new application has been installed
Intent.ACTION_POWER_CONNECTED	The device has been plugged in
Intent.ACTION_POWER_DISCONNECTED	The device has been disconnected again
KeyChain.ACTION_STORAGE_CHANGED	The key store has changed
BluetoothDevice.ACTION_ACL_CONNECTED	A Bluetooth ACL connection has been established
AudioManager.ACTION_AUDIO_BECOMING_ NOISY	The internal audio speaker is about to be used instead of other output means (like a headset)

Role of Filters

- When Intent is sent to the Android system, it determines suitable applications for this Intent
- If several components have been registered for this type of Intent, Android offers the user the choice to open one of them
- This decision is based on IntentFilters
- An Intent filter is an instance of the IntentFilter class

Intent Filter Example

- Following Code Snippet demonstrates how to create an Intent Filter to trigger an activity:

```
<activity android:name=".BrowserActivitiy"
android:label="@string/app_name">
<Intent-filter>
<action android:name="android.Intent.action.VIEW" />
<category android:name="android.Intent.category.DEFAULT" />
<data android:scheme="http"/>
</Intent-filter>
</activity>
```

Intent Matching

- Matching of intents with intent filters is performed to discover a target component to activate
- Also used to get information about the set of components available on the device
- Android system populates the application launcher, by finding all the activities with intent filters that specify the android.Intent.action.MAIN action and android.Intent.category.LAUNCHER category

Intent Matching Rules

- To match an IntentFilter with an Intent, three conditions must be fulfilled - the action, the category, and the data (both the data type and data scheme+authority+path, if specified) must match
- The Data characteristic is divided into four attributes:
  - Types
  - Schemes
  - Authority
  - Path
- Data Scheme matches when any of the given values match the Intent data's scheme
- Data Authority matches the given values with Intent data's authority
- Data Path matches any given values with the Intent's data path and when both a scheme

Filters in Manifest

- By using intent filters, components specify their capability that is, the kinds of Intents they can respond to
- Intent filters are specified in the manifest as <Intent-filter> elements
- A component can have any number of filters, every filter describing a diverse capability
- When an intent explicitly names a target component, it activates that component; the filter does not play any role
- When Intent does not specify a target by name, it activates a component only if it can pass through one of the component's filters
- Following Code Snippet demonstrates how to create a Intent Filter in the AndroidManifest File:

```
<intent-filterandroid:icon="resource path from drawables"
android:label="resource path of string" android:priority="integer">

</intent-filter>
```

Filters in Broadcast Receivers

- When the user registers a BroadcastReceiver to be executed in the main activity thread, the receiver is called in the main application thread
- The system can broadcast Intents that are 'sticky'
- There might be times when multiple sticky Intents may match the filter
- Only one of these Intents can be returned directly by the function and that is randomly decided by the system
- When the user knows that the registered Intent is sticky, then null can be supplied for the receiver
- Following Code Snippet demonstrates how to create an Intent Filter in Broadcast Receivers:

```
…
<receiverandroid:name=".BCastReceiver">
<intent-filter>
<action android:name="android.Intent.action.MAIN"/>
<category android:name="android.Intent.category.LAUNCHER"/>
<action android:name="android.Intent.action.ACTION_POWER_ CONNECTED"/>
</intent-filter>
</receiver>
…
```

Summary

- A service is an application component that is able to carry out long-running operations in the background. It does not provide a user interface
- In order to interact with the components, a service can let other components bind to it and perform Inter Process Communication (IPC). A service runs in the main thread of the application that hosts it
- A Broadcast Receiver is a component that responds to system-wide broadcast announcements
- Activities, Services, and Broadcast Receivers have intent filters to inform the system which intents they can handle
- Intent filters can handle two types of intents: Implicit and Explicit
- Matching of intents with intent filters is done to discover a target component to be activated, and also to get information about the set of components available on the device
- To match an intent filter with an Intent, three conditions must be fulfilled: the action, category, and the data