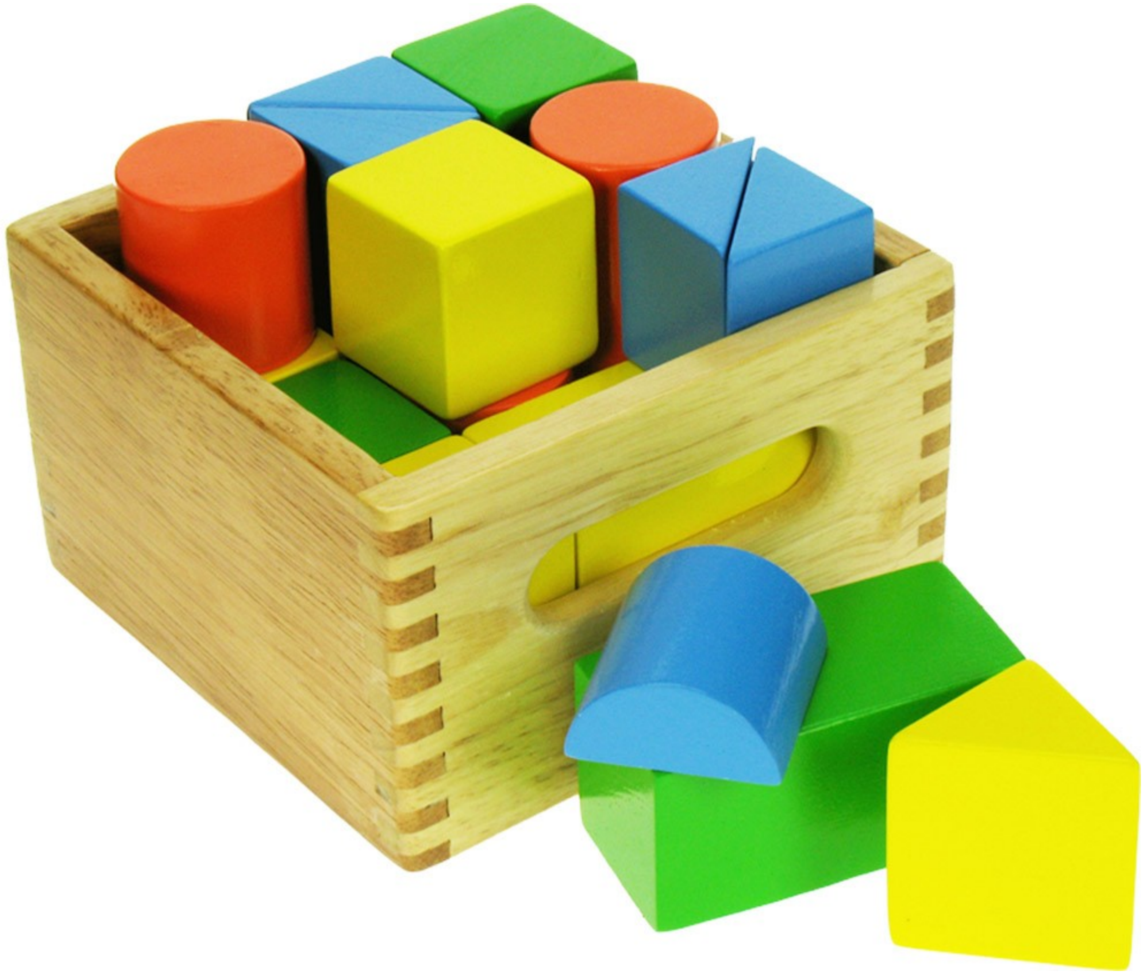
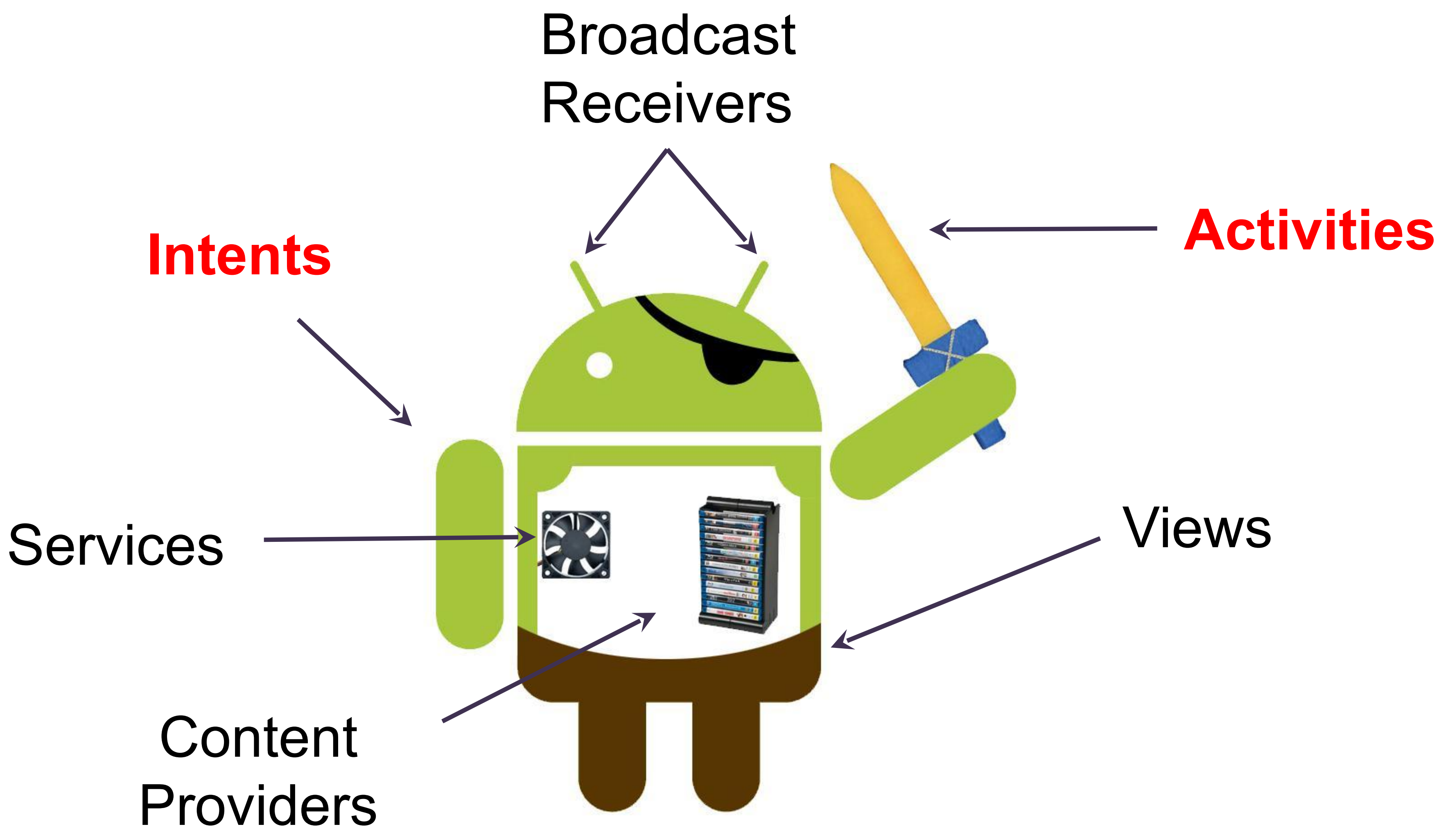
Android Application Building Blocks



Homework stats

Intents and Intent Filters

Anatomy of Android application



Intents

- Message-passing mechanism on Android
- Facility for late run-time binding between components
  - activities, services, broadcast receivers
  - same or different applications

- Passive data structure describing
  - operation to be performed
  - something that has happened

Intents In Action

(A) Activity starts another activity by sending an Intent

```java
public void callActivityTwo(View view) {
    final Intent intent =
            new Intent(this, NewActivity.class);

    startActivity(intent);
}
```

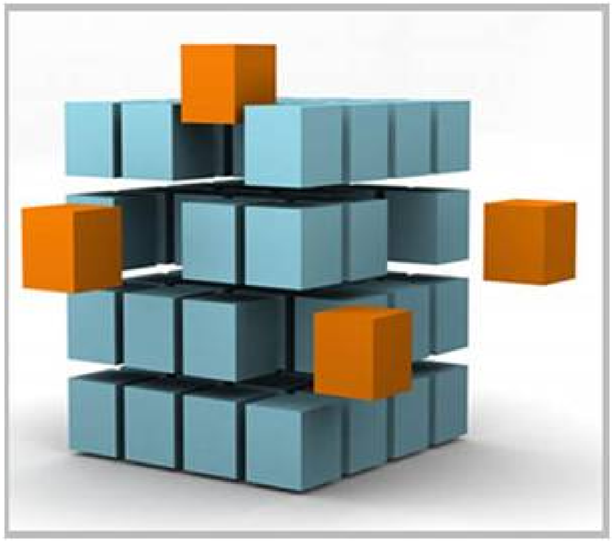
(B) Activity starts another activity by creating an intent that says “View site javaguru.lv”

```java
public void openSite(View view) {
    final Intent intent =
            new Intent(Intent.ACTION_VIEW,
                    Uri.parse("http://javaguru.lv"));

    startActivity(intent);
}
```

Intents

Action propagation via Intents is Android design principle

- modular architecture
- event-driven applications
- decoupling of components
- seamless replacement of application elements



Intent Object

- Component name
  - Component name that should handle the intent
  - setClassName("package", "package.Activity")
    setClassName(this, "package.Activity")
- Action
  - string naming the action to be performed
  - determines how data and extras fields are structured
  - ex., ACTION_VIEW, ACTION_CALL, ACTION_EDIT
- Data
  - URI and the MIME type of the data

Intent Object

- Common Action/Data Pairs
  - ACTION_VIEW http://www.javaguru.lv
    - view site in browser
  - ACTION_DIAL content://contacts/people/1
    - dial person
  - ACTION_VIEW tel:123
    - show dialer with the number
  - ACTION_DIAL tel:123
    - dial the number
  - ACTION_VIEW content://contacts/people/
    - list of contacts

Intent Object

- Category
  - Additional information about the target component
  - LAUNCHER - initial activity of a task

    HOME - activity displays the home screen

    PREFERENCE - activity is a preference panel
- Extras
  - Additional information delivered to the component handling the intent (key-value pairs)
- Flags

Intent Resolution

- Determine component to handle passed intent
- Types of Intents
  - Explicit intents - designate the target component by its class name

    new Intent(this, ActivityX.class)

  - Implicit intents - do not name a target; component to handle the intent is found via intent filters

    new Intent(ACTION_VIEW,Uri.parse("http://lv"))

Intent Filters

- Set up in application's manifest
- Describe capabilities of target components
- Inform which implicit intent a component can handle
- Intent object are tested against intent filters
  - Action, Category, Data
- User may be asked to choose is intent can pass through the filters of multiple activities

Intent Filters in Action

- Filter fields parallel action, data, category fields of Intent

- **Action test**
  - Intent action must match one of the filter actions

```
<intent-filter . . . >
    <action android:name="com.example.project.SHOW_CURRENT" />
    <action android:name="com.example.project.SHOW_RECENT" />
    <action android:name="com.example.project.SHOW_PENDING" />
    . . .
</intent-filter>
```

Intent Filters in Action

- **Category Test**
  - Every Intent category must match a category in the filter
    - NB! intents passed to startActivity() are assigned "android.intent.category.DEFAULT"

```
<intent-filter . . . >
    <category android:name="android.intent.category.DEFAULT" />
    <category android:name="android.intent.category.BROWSABLE" />
    . . .
</intent-filter>
```

Intent Filters in Action

- **Data Test**
  - specify URI and data type
  - separate attributes for URI parts (scheme, host, port, and path)
  - Intent URI is compared to the parts of the URI in filter
  - ex. <data android:mimeType="image/*" />

    <data android:scheme="http" android:type="video/*" />

```
<intent-filter . . . >
    <data android:mimeType="video/mpeg" android:scheme="http" . . . />
    <data android:mimeType="audio/mpeg" android:scheme="http" . . . />
    . . .
</intent-filter>
```

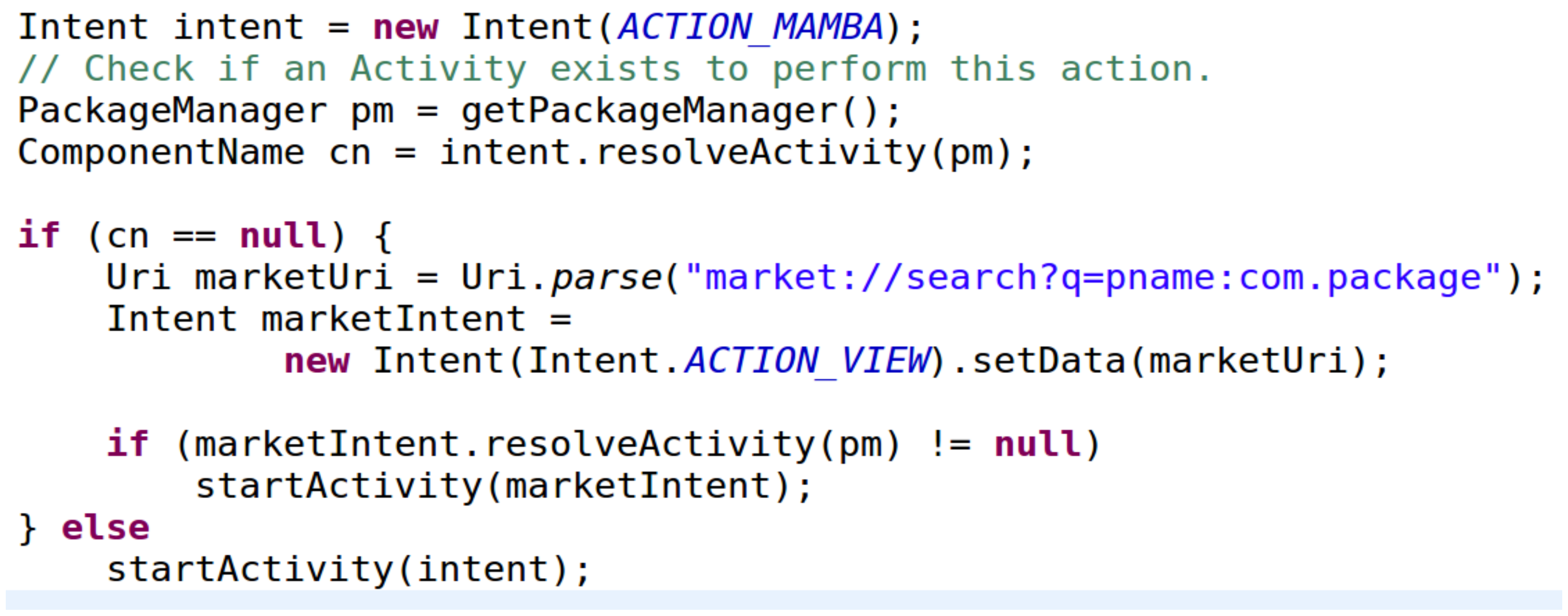
Intent Filters in Action

- Activities that can initiate applications have filters with "android.intent.action.MAIN" action
- Activities to be represented in the application launcher specify "android.intent.category.LAUNCHER" category

```
<activity
    android:name="com.example.intent1.MainActivity"
    android:label="@string/app_name" >
    <intent-filter>
        <action android:name="android.intent.action.MAIN" />
        <category android:name="android.intent.category.LAUNCHER" />
    </intent-filter>
</activity>
```

Intent Kung Fu

- Determining if an Intent will resolve before calling startActivity



```java
Intent intent = new Intent(ACTION_MAMBA);
// Check if an Activity exists to perform this action.
PackageManager pm = getPackageManager();
ComponentName cn = intent.resolveActivity(pm);

if (cn == null) {
    Uri marketUri = Uri.parse("market://search?q=pname:com.package");
    Intent marketIntent =
            new Intent(Intent.ACTION_VIEW).setData(marketUri);

    if (marketIntent.resolveActivity(pm) != null)
        startActivity(marketIntent);
} else
    startActivity(intent);
```

Intent Kung Fu

- Returning result from Activities
    - Start Activity as a sub-Activity that can pass results back to its parent

```
public void openSite(View view) {
    final Intent intent = new Intent(this, SubActivity.class);
    startActivityForResult(intent, SUBACT_REQUEST_CD);
}

@Override
protected void onActivityResult(int requestCode, int resultCode,
        Intent data) {

    if (requestCode == SUBACT_REQUEST_CD) {
        if (resultCode == RESULT_OK) {
            String response = data.getExtras()
                    .getString(SUBACT_REQUEST_PARAM1);
            Toast.makeText(this, response, Toast.LENGTH_LONG).show();
        }
    }
```

Intent Kung Fu

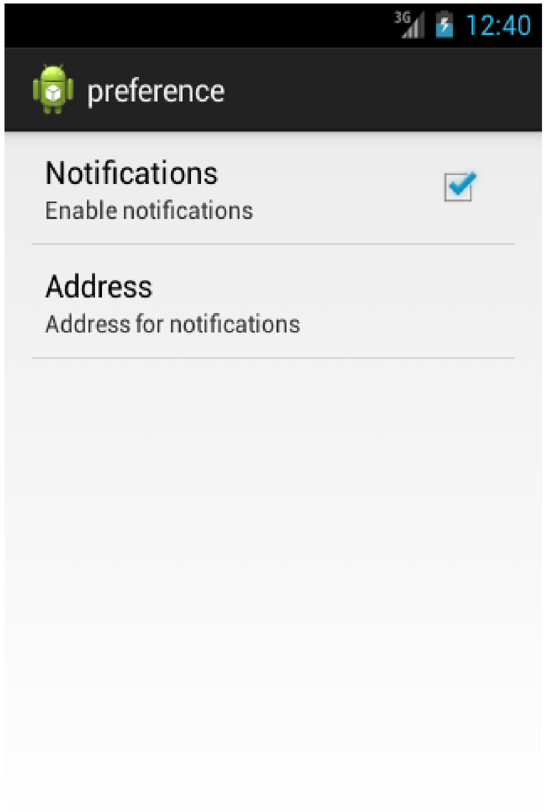
- Returning result from Activities

```
public void ok(View view) {
    EditText editText = (EditText) findViewById(R.id.edittext1);

    Intent result = new Intent(Intent.ACTION_PICK);
    result.putExtra(SUBACT_REQUEST_PARAM1,
            editText.getEditableText().toString());

    setResult(RESULT_OK, result);
    finish();
}
```

Intent Practical

A) Application Preferences

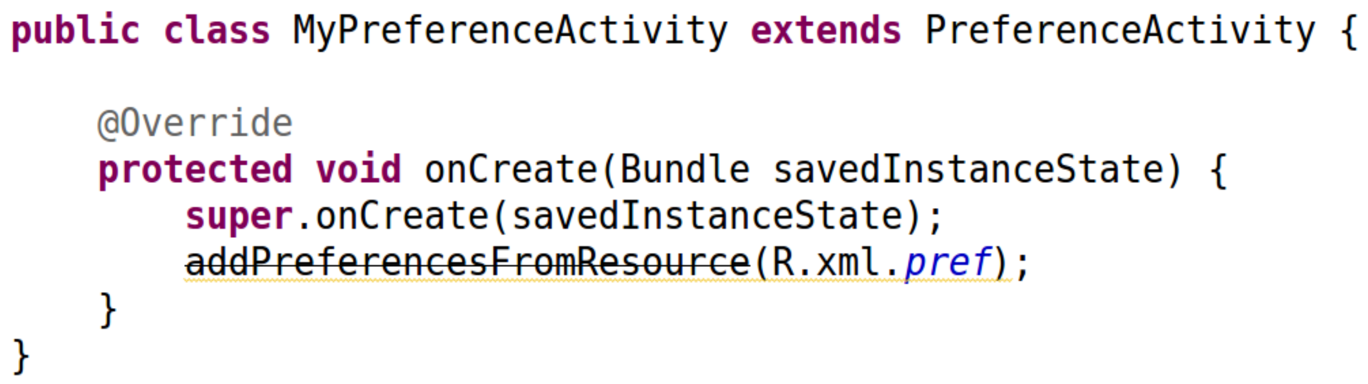
- Continue working on Purchase list application
- Add new activity that extends PreferenceActivity
  - base class for an activity to show a hierarchy of preferences
- Use xml configuration (res/xml/pref.xml)
- Call preferences screen with explicit Intent



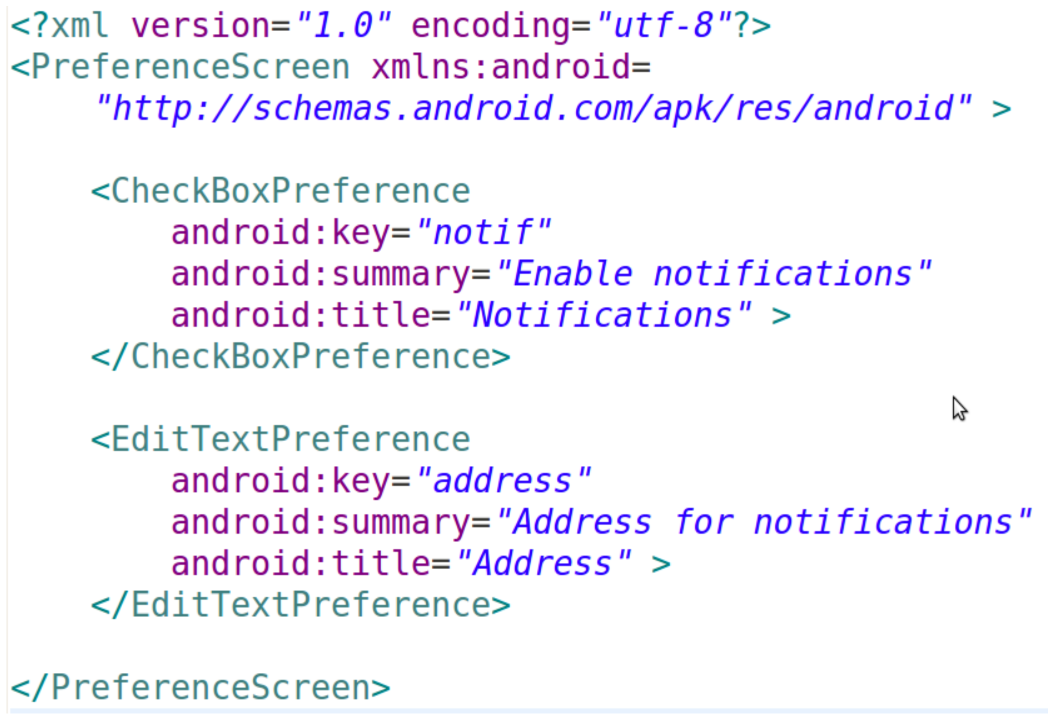
Notifications
Enable notifications ✓

Address
Address for notifications

Intent Practical



```
public class MyPreferenceActivity extends PreferenceActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        ~~addPreferencesFromResource~~(R.xml.pref);
    }
}
```

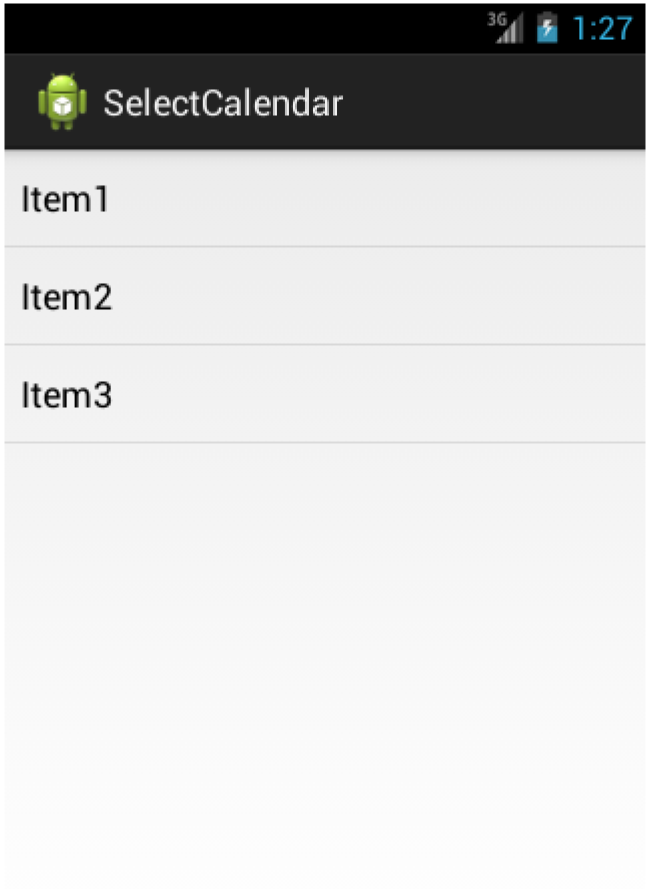


```
<?xml version="1.0" encoding="utf-8"?>
<PreferenceScreen xmlns:android=
    "http://schemas.android.com/apk/res/android" >

    <CheckBoxPreference
        android:key="notif"
        android:summary="Enable notifications"
        android:title="Notifications" >
    </CheckBoxPreference>

    <EditTextPreference
        android:key="address"
        android:summary="Address for notifications"
        android:title="Address" >
    </EditTextPreference>

</PreferenceScreen>
```

Intent Practical

B) Purchase list select activity

- Continue working on Purchase list application
- Add new activity SelectPurchaseBasket to choose one of possible baskets for goods
  - Use ListView with items populated from resource
- Use implicit Intent to start SelectPurchaseBasket via startActivityForResult()
- Return selected basket item from SelectPurchaseBasket via setResult()
- Show selected list item text in MainActivity



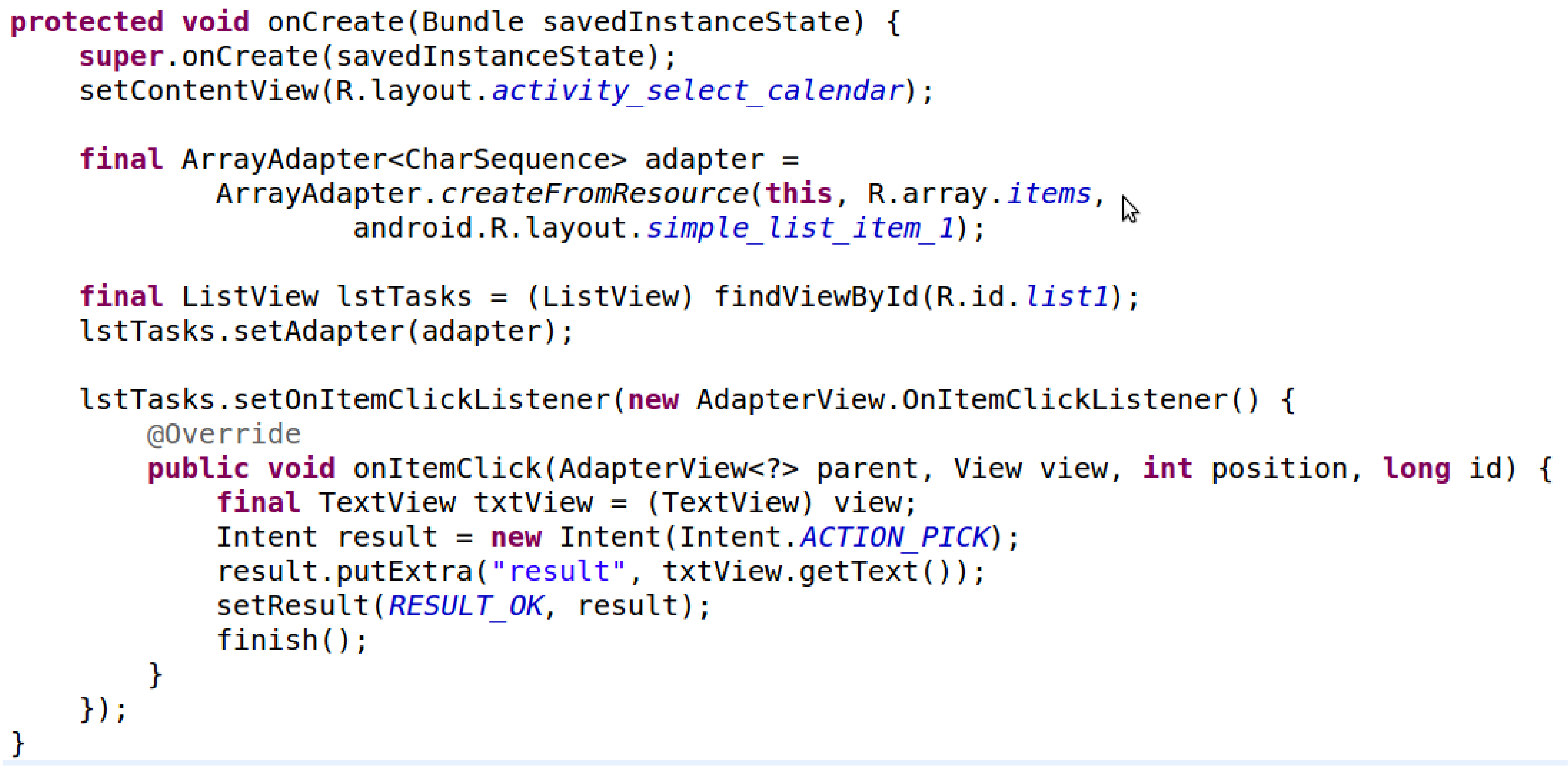
Intent Practical

- Main Activity

```
public static final String ACTION_CALENDAR_SELECT =
        "com.example.preference.action.CALENDAR_SELECT";
public static final int SELECT_CALENDAR_REQUEST_CD = 1;
public static final String SELECT_CALENDAR_RESP = "result";

public void openSelect(View view) {
    final Intent intent = new Intent(ACTION_CALENDAR_SELECT);
    startActivityForResult(intent, SELECT_CALENDAR_REQUEST_CD);
}

@Override
protected void onActivityResult(int requestCode, int resultCode, Intent data) {
    if (requestCode == SELECT_CALENDAR_REQUEST_CD) {
        if (resultCode == RESULT_OK) {
            String response = data.getExtras().getString(SELECT_CALENDAR_RESP);
            TextView txtView = (TextView)findViewById(R.id.textView1);
            txtView.setText(response);
        }
    }
}
```

Intent Practical

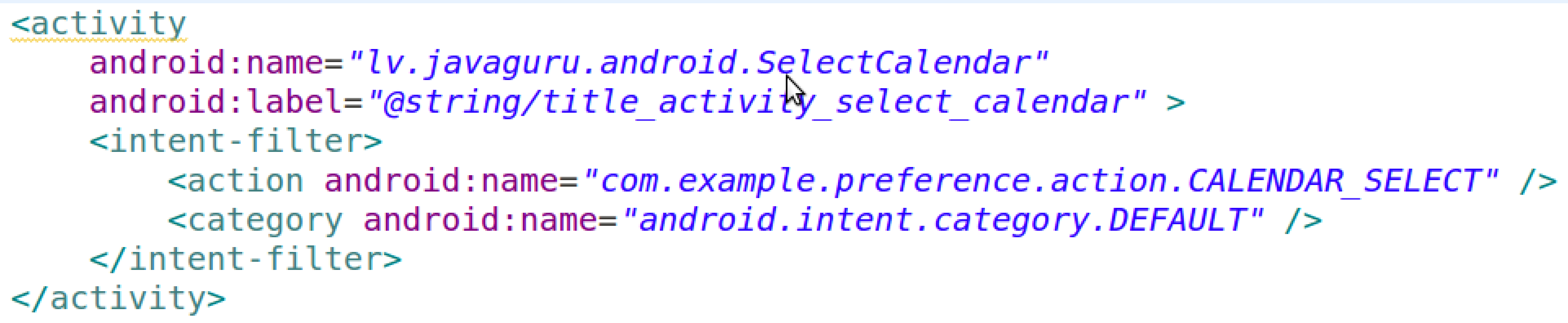
- List item select Activity



```java
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_select_calendar);

    final ArrayAdapter<CharSequence> adapter =
            ArrayAdapter.createFromResource(this, R.array.items,
                    android.R.layout.simple_list_item_1);

    final ListView lstTasks = (ListView) findViewById(R.id.list1);
    lstTasks.setAdapter(adapter);

    lstTasks.setOnItemClickListener(new AdapterView.OnItemClickListener() {
        @Override
        public void onItemClick(AdapterView<?> parent, View view, int position, long id) {
            final TextView txtView = (TextView) view;
            Intent result = new Intent(Intent.ACTION_PICK);
            result.putExtra("result", txtView.getText());
            setResult(RESULT_OK, result);
            finish();
        }
    });
}
```

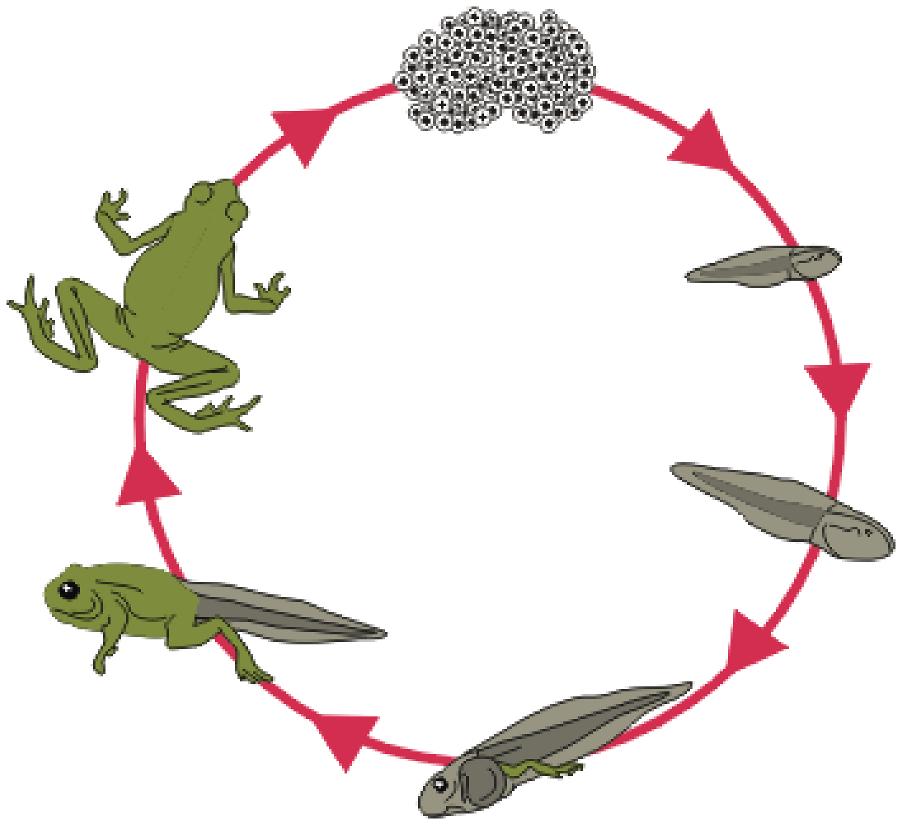
Intent Practical

- Intent Filter in AndroidManifest.xml



```xml
<activity
    android:name="lv.javaguru.android.SelectCalendar"
    android:label="@string/title_activity_select_calendar" >
    <intent-filter>
        <action android:name="com.example.preference.action.CALENDAR_SELECT" />
        <category android:name="android.intent.category.DEFAULT" />
    </intent-filter>
</activity>
```

Activity Life Cycle

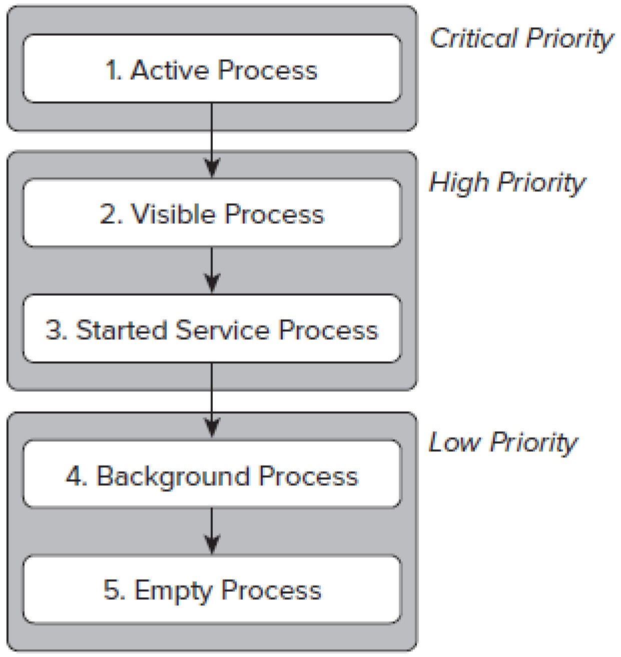


Android Application

- One or more loosely bound Activities
  - Typically, one is marked “main”
  - Each activity can start another via Intents
- Has its own process with separate instance of Dalvik by default
- Limited control over own lifecycle. Instead, application components must listen for changes in the application state and react accordingly

Android Application

- Android aggressively manages its resources to ensure smooth UX
- Processes (and their hosted applications) might be killed to free resources for higher-priority applications
- Application's priority is influenced by its highest-priority Activity

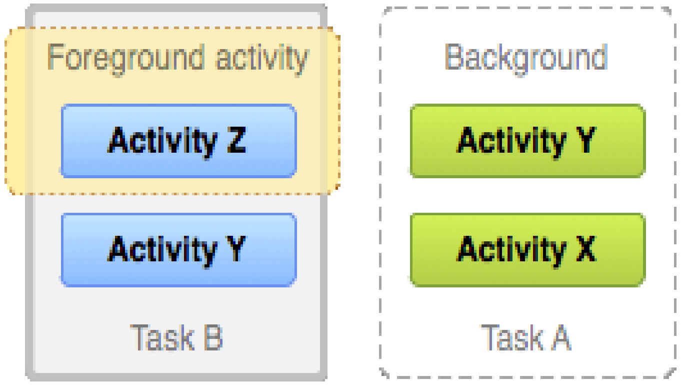


Activity Stacks

- Activities are managed as activity stack ("back stack").
  - user is switching activities
  - new activity is placed on the top and becomes the running one
  - previous activity remains below it in the stack, and will not come to the foreground again until the new activity exits

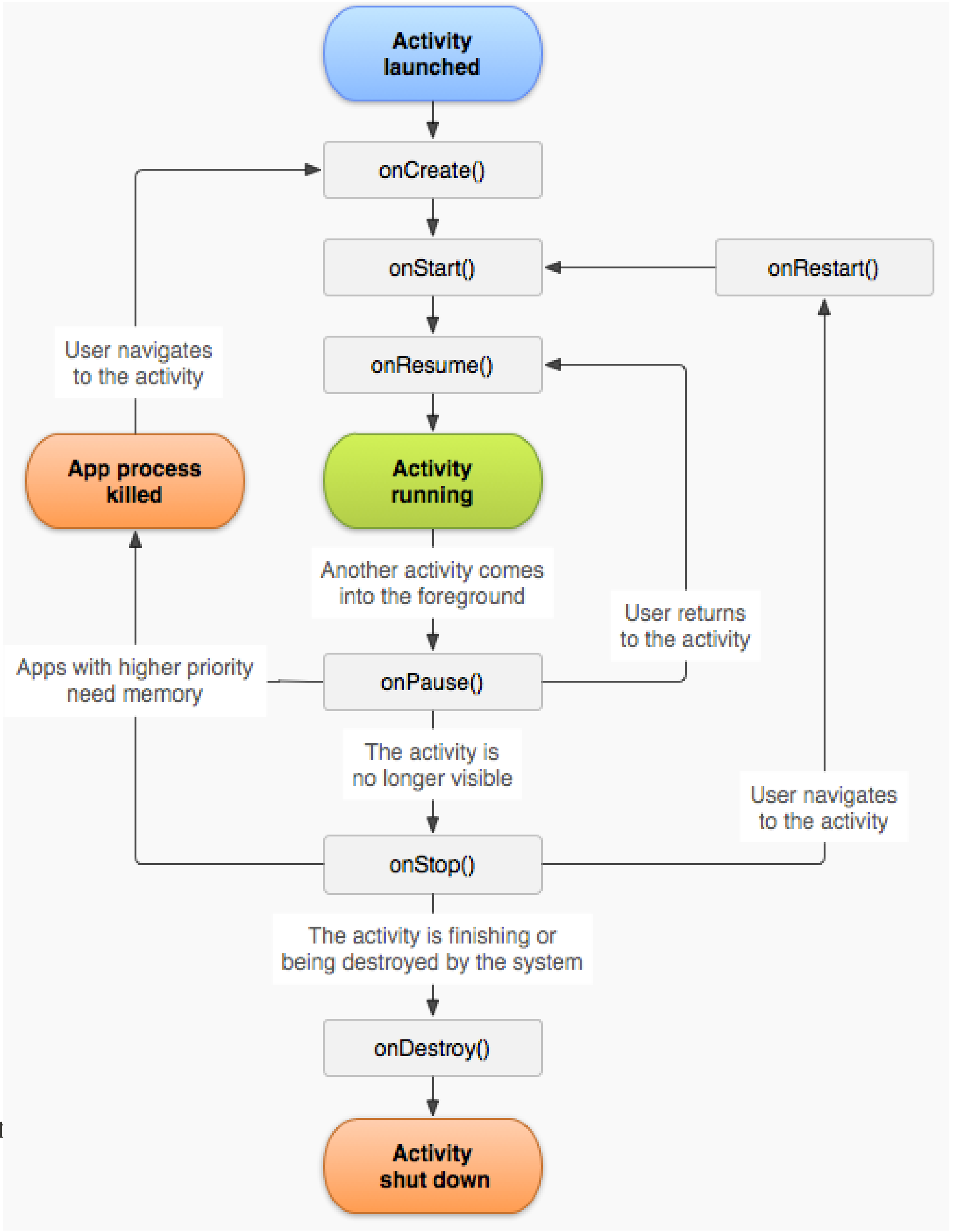
Multitasking

- Task - collection of activities user interacts with performing a certain job
- Home screen – task starting place
  - Application's task comes to the foreground when user touches an icon in the application launcher
  - New task is created and "main" application activity opens as the root activity if no task exists



Activity States

- Activities transition four possible states
    - Active — activity is at the top of the stack, visible, focused
    - Paused — visible Activity without focus
    - Stopped — when Activity isn't visible, it "stops."
    - Inactive — after Activity is killed, and before it's been launched

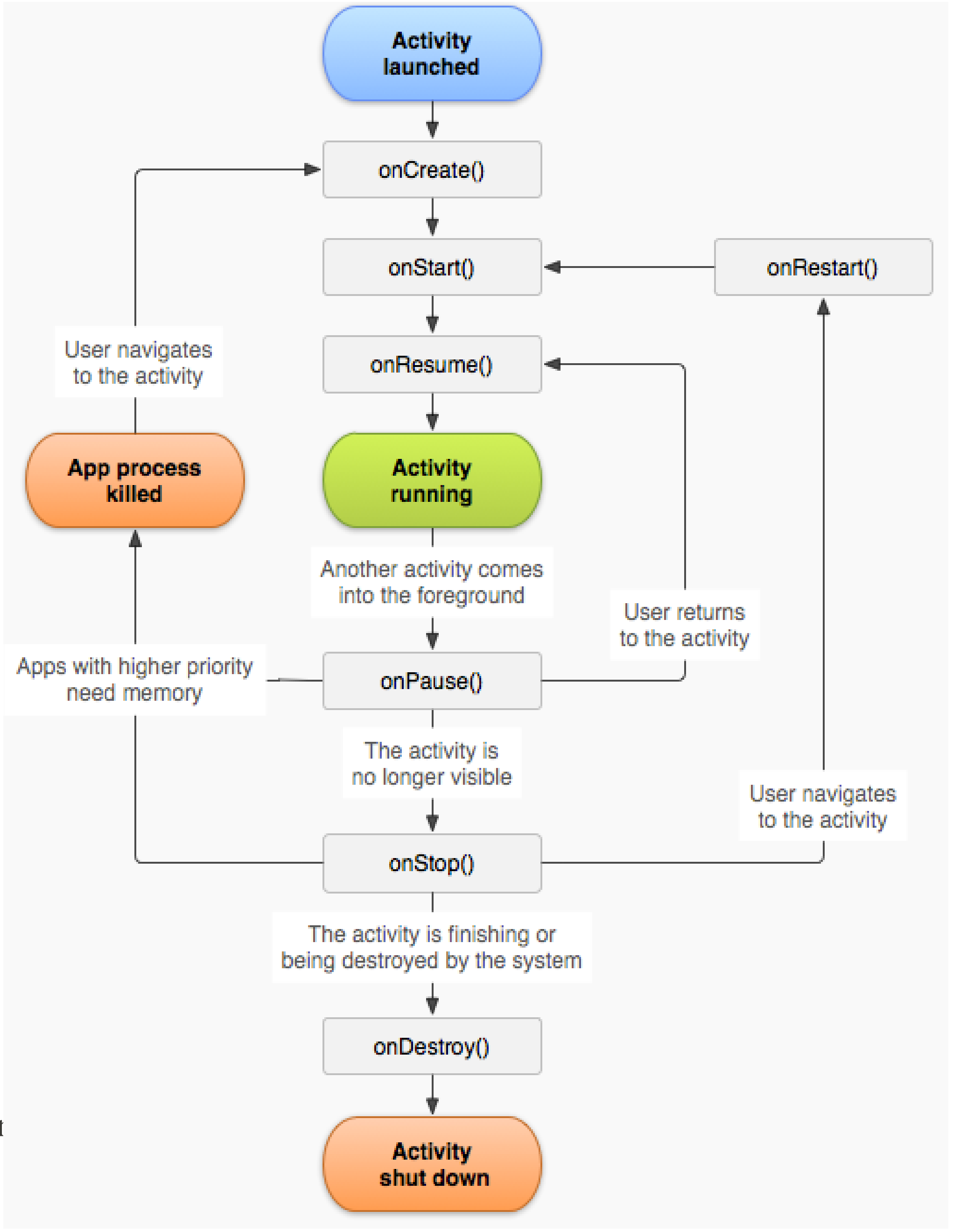

Activity launched
onCreate()
onStart()
onRestart()
User navigates to the activity
onResume()
App process killed
Activity running
Another activity comes into the foreground
User returns to the activity
Apps with higher priority need memory
onPause()
The activity is no longer visible
User navigates to the activity
onStop()
The activity is finishing or being destroyed by the system
onDestroy()
Activity shut down

Activity States

- Activity has callback methods to perform operations when the Activity moves between states
  - onCreate() - initialize the essential components. Define the layout for the activity's user interface via setContentView()
  - OnPause() - commit any changes that should be persisted beyond the current user session

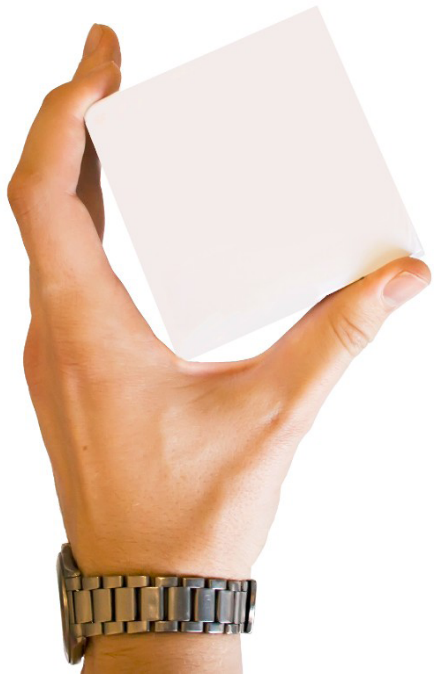
Activity Lifetimes

- Full Lifetime
  - between the first call to onCreate and the final call to onDestroy
- Visible Lifetime
  - bound between calls to onStart and onStop
- Active Lifetime
  - starts with onResume and ends with onPause


Activity launched
onCreate()
onStart()
onRestart()
User navigates to the activity
onResume()
App process killed
Activity running
Another activity comes into the foreground
User returns to the activity
Apps with higher priority need memory
onPause()
The activity is no longer visible
User navigates to the activity
onStop()
The activity is finishing or being destroyed by the system
onDestroy()
Activity shut down

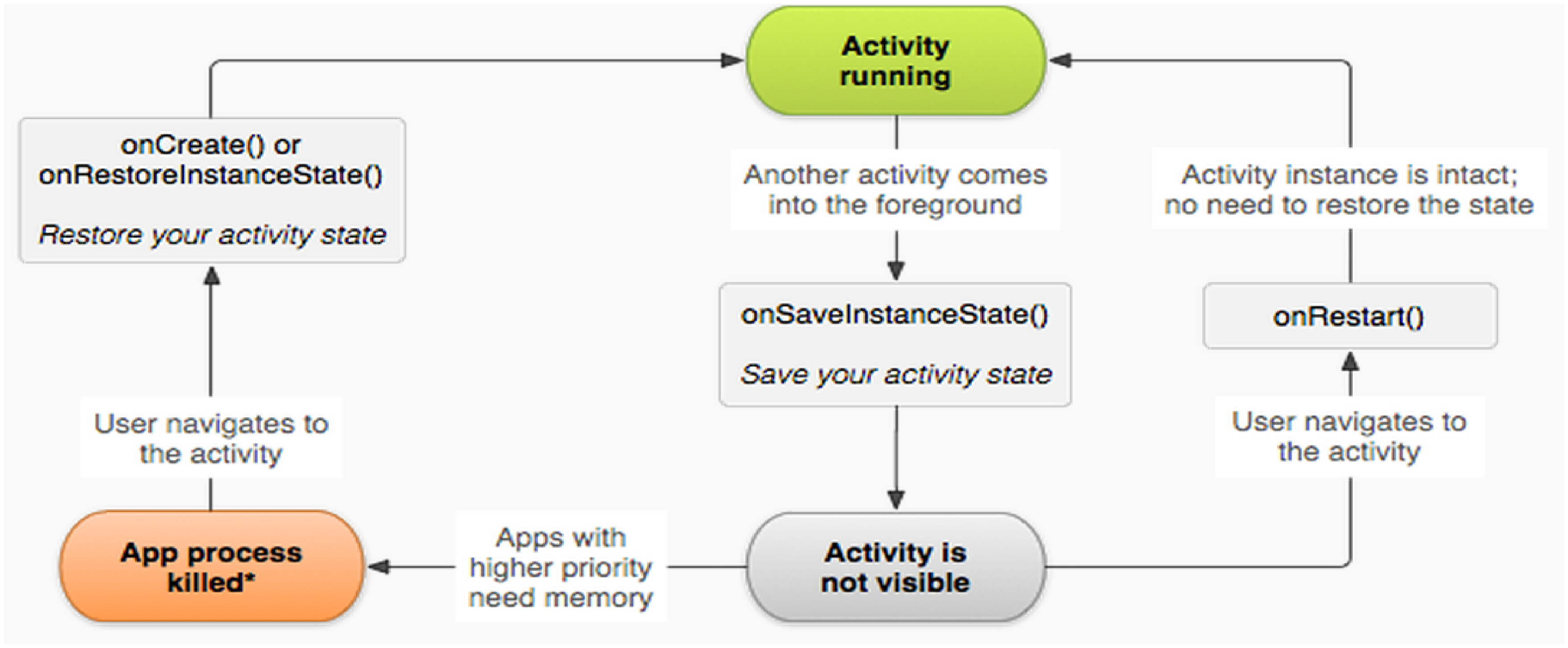
Saving Activity State

- Problem
  - When an activity is paused or stopped, its state is retained while Activity object is held in memory
  - After an activity is destroyed the system cannot simply resume activity with its state intact
- Solution
  - The system recreates destroyed Activity object if the user navigates back to it



Saving Activity State

- Activity state can be preserved with onSaveInstanceState() callback
- To restore use onCreate() and onRestoreInstanceState()


Activity running
Another activity comes into the foreground
onSaveInstanceState()
Save your activity state
Activity is not visible
Apps with higher priority need memory
App process killed*
User navigates to the activity
onCreate() or onRestoreInstanceState()
Restore your activity state
User navigates to the activity
onRestart()
Activity instance is intact; no need to restore the state

Saving activity state

- Save state information about the activity as name-value pairs in a Bundle
- onSaveInstanceState() is not guaranteed to be called, never use it to store persistent data (use onPause())
- onSaveInstanceState() method is called for every View in the layout by default

```
protected void onSaveInstanceState(Bundle outState) {
    outState.putCharSequenceArrayList("todoList", todoList);
};
```

Activity Practical

- **Improve purchase list application UX**
  - Continue working on Purchase list application
  - Save and restore state information about purchase list entries

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

    ArrayList<CharSequence> savedList = null;
    if (savedInstanceState != null) {
        savedList =  savedInstanceState.getCharSequenceArrayList("todoList");
    }

    todoList = savedList != null ? savedList : new ArrayList<CharSequence>();
    final ArrayAdapter<CharSequence> todoListAdapter =
            new ArrayAdapter<CharSequence>(this,
                    android.R.layout.simple_list_item_1, todoList);
```

Application Manifest

Application Manifest

Essential information about the application

- Names Java package for the application
- Specifies application metadata (icon, version number, theme)
- Describes components of the application
- Declares application permissions
- Declares Android API versions
- Lists the libraries that the application must be linked against

<action>

<activity>

<activity-alias>

<application>

<category>

<data>

...

<intent-filter>

<uses-feature>

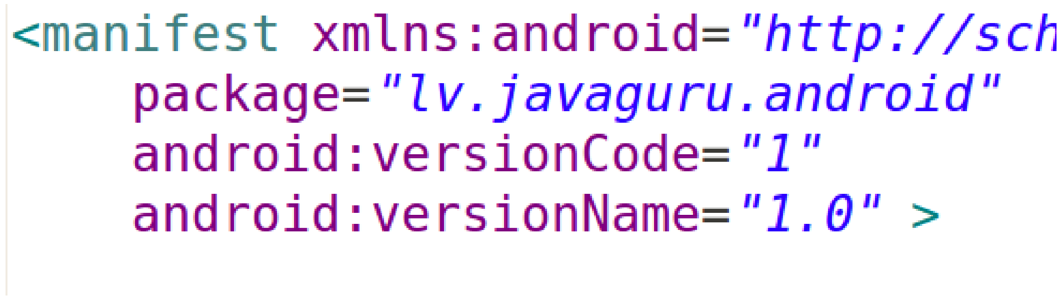
<uses-library>

<uses-permission>

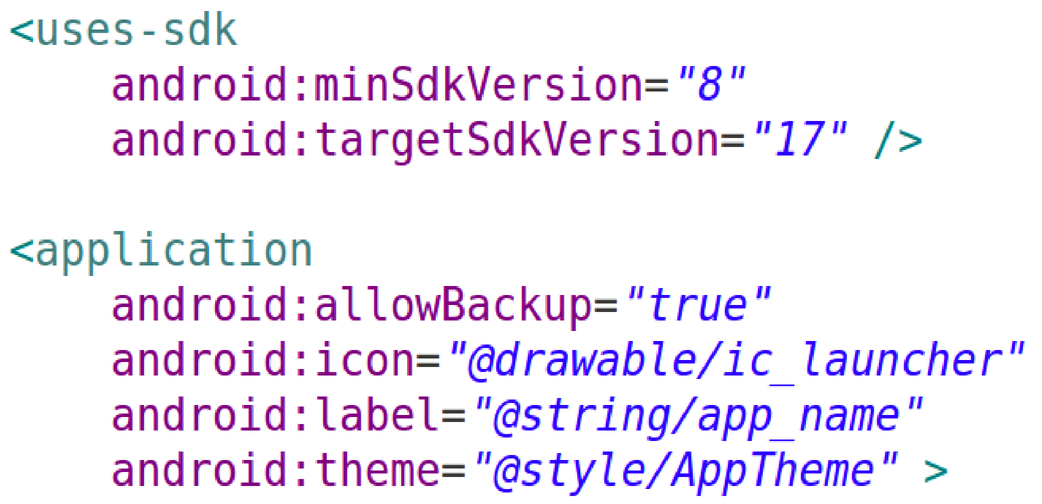
<uses-sdk>

Application Manifest

- The minimum SDK version specifies the lowest version supported
- The target SDK version specifies the platform used for development and testing.



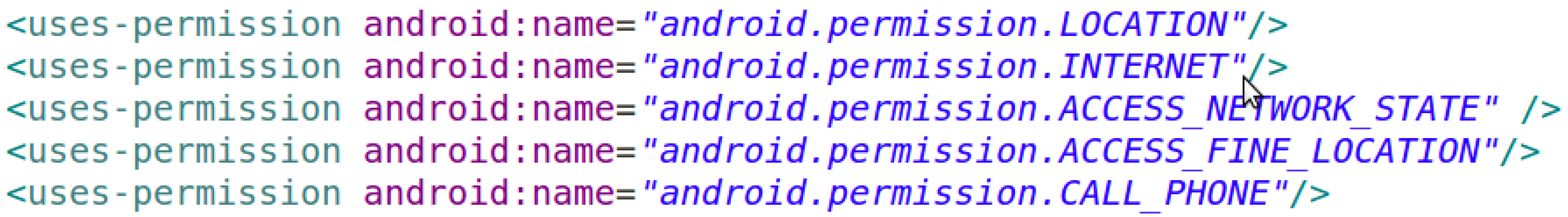
```
<manifest xmlns:android="http://sch
    package="lv.javaguru.android"
    android:versionCode="1"
    android:versionName="1.0" >
```



```
<uses-sdk
    android:minSdkVersion="8"
    android:targetSdkVersion="17" />

<application
    android:allowBackup="true"
    android:icon="@drawable/ic_launcher"
    android:label="@string/app_name"
    android:theme="@style/AppTheme" >
```

Permissions

- A permission limits access to a part of the code or to data on the device
- Application must declare that it requires that permission with a <uses-permission>
- An application can also protect its own components (activities, services, broadcast receivers, and content providers)



```
<uses-permission android:name="android.permission.LOCATION"/>
<uses-permission android:name="android.permission.INTERNET"/>
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE" />
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
<uses-permission android:name="android.permission.CALL_PHONE"/>
```

Features

- Use uses-feature nodes to specify which features your application requires
- Prevents your application from being installed on a device w/o required piece of hardware

<uses-feature android:name=”android.hardware.nfc” />