



# ANDROID DEVELOPMENT

## DATA PERSISTENCE

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- Methods of persistence
  - Shared Preferences for application
  - Activity Instance State
  - Internal Storage
    - Device memory
  - External Storage
    - Shared external storage



# Shared Preferences

- Shared Preferences allow for **key-value pairs** of primitive data types to be saved/restored
- They are persistent across **user sessions** and **system reboot**



# Emulator's Device File Explorer

MyApplication4 [C:\Users\cherwah\AndroidStudioProjects\MyApplication4] - ...app\src\main\java\com\example\myapplication\MainActivity.java [app] - Android Studio

File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help

Tool Windows

- Quick Definition Ctrl+Shift+F
- Show Siblings
- Quick Documentation Ctrl+Q
- Jump to Source
- Show Source Ctrl+Enter
- Recent Files Ctrl+E
- Recently Changed Files Ctrl+Shift+E
- Recent Changes Alt+Shift+C
- Compare With... Ctrl+D
- Compare with Clipboard
- Quick Switch Scheme... Ctrl+~
- Toolbar
- Tool Buttons
- Status Bar
- Navigation Bar
- Bidi Text Direction
- Enter Presentation Mode
- Enter Distraction Free Mode
- Enter Full Screen

Project

- Project
- Run
- Debug
- Logcat
- Structure
- Version Control
- Profiler
- Assistant
- Build
- Build Variants
- Capture Analysis
- Capture Tool
- Layout Captures
- Designer
- Device File Explorer
- Event Log
- Gradle
- Image Layers
- Palette
- Preview
- Resource Manager
- Terminal
- Theme Preview
- TODO

MainActivity

```
elId = "101";
ationChannel(channelId);
ation(channelId);

ateNotification(String channelId) {
    = new Intent( packageContext: this, MainActivity.class);
gs(Intent.FLAG_ACTIVITY_NEW_TASK | Intent.FLAG_A
it pendingIntent = PendingIntent.getActivity( context: th

ompat.Builder builder = new NotificationCompat.Builder(
allIcon(R.drawable.ic_launcher_foreground)
ntentTitle("Jean says")
ntentText("Want to grab dinner tonight?")
rity(NotificationCompat.PRIORITY_DEFAULT)
the intent that will fire when the user taps the notifica
ntentIntent(pendingIntent)
toCancel(true);

anagerCompat notificationManager = NotificationManag
otty = builder.build();
anager.notify( id: 0, notty);

ateNotificationChannel(String channelId) {
    NotificationChannel, but only on API 26+ because
// the NotificationChannel class is new and not in the support library
if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
    NotificationChannel channel = new NotificationChannel(
        channelId,
        name: "My Channel Name",
        NotificationManager.IMPORTANCE_DEFAULT
    );
    channel.setDescription("My Channel Description");

    // Register the channel with the system
    NotificationManager notificationManager = getSystemService(No

MainActivity > onCreate()
```

Device File Explorer

Emulator Pixel\_2\_API\_28 Android 9, API 28

Name	Permissi...	Date	Size
acct	dr-xr-xr-x	2019-05-21 02:00	0 B
bin	lrw-r--r--	2009-01-01 08:00	11 B
cache	drwxrwxr-x	2009-01-01 08:00	4 KB
config	drwxr-xr-x	2019-05-21 02:00	0 B
d	lrw-r--r--	2009-01-01 08:00	17 B
data	drwxrwxr-x	2019-05-21 02:01	4 KB
dev	drwxr-xr-x	2019-05-21 02:00	2.6 KB
etc	lrw-r--r--	2009-01-01 08:00	11 B
lost-found	drwx-----	2009-01-01 08:00	16 KB
mnt	drwxr-xr-x	2019-05-21 02:00	240 B
odm	drwxr-xr-x	2009-01-01 08:00	4 KB
oem	drwxr-xr-x	2009-01-01 08:00	4 KB
proc	dr-xr-xr-x	2019-05-21 02:00	0 B
product	lrw-r--r--	2009-01-01 08:00	15 B
sbin	drwxr-xr-x	2009-01-01 08:00	4 KB
sdcard	lrw-r--r--	2009-01-01 08:00	21 B
Alarms	drwxrwxr-x	2019-05-21 02:02	4 KB
Android	drwxrwxr-x	2019-05-21 02:02	4 KB
DCIM	drwxrwxr-x	2019-05-21 02:02	4 KB
Download	drwxrwxr-x	2019-05-21 02:02	4 KB
Movies	drwxrwxr-x	2019-05-21 02:02	4 KB
Music	drwxrwxr-x	2019-05-21 02:02	4 KB
Notifications	drwxrwxr-x	2019-05-21 02:02	4 KB
Pictures	drwxrwxr-x	2019-05-21 02:02	4 KB
Podcasts	drwxrwxr-x	2019-05-21 02:02	4 KB
Ringtones	drwxrwxr-x	2019-05-21 02:02	4 KB
storage	drwxr-xr-x	2019-05-21 02:02	100 B
sys	dr-xr-xr-x	2019-05-21 02:00	0 B
system	drwxr-xr-x	2009-01-01 08:00	4 KB
vendor	drwxr-xr-x	2009-01-01 08:00	4 KB
bugreports	lrw-r--r--	2009-01-01 08:00	50 B
charger	lrw-r--r--	2009-01-01 08:00	13 B
default.prop	lrw-----	2009-01-01 08:00	23 B

Build: Build Output x Sync x

Build: completed successfully at 5/22/2019 11:04 AM

- Starting Gradle Daemon
- Run build C:\Users\cherwah\AndroidStudioProjects\MyApplication4
  - Load build
  - Configure build
  - Calculate task graph
  - Run tasks

50:1 CRLF UTF-8 4 spaces



# Reading SharedPreferences

- Default shared preference is read via **getDefaultSharedPreferences()**
- No need to provide a filename
- To get, use **getXXX()** where **XXX** is a **type**

```
SharedPreferences pref = PreferenceManager.getDefaultSharedPreferences(getApplicationContext());  
  
String hostname = pref.getString("hostname", "localhost");  
boolean toEcho = pref.getBoolean("echo", true);
```

- Shared Preference is modified with a **SharedPreferences.Editor** via a **commit()** or **apply()**
- **commit()** writes to hard-disk **synchronously**
- **apply()** saves to memory synchronously, then writes to hard-disk **asynchronously** (in the background)

```
SharedPreferences pref = PreferenceManager.getDefaultSharedPreferences(getApplicationContext());
SharedPreferences.Editor editor = pref.edit();

editor.putString("hostname", "localhost");
editor.putBoolean("echo", true);

// editor.commit(); // synchronous
editor.apply(); // asynchronous
```



# View saved preferences on Emulator

The screenshot shows the Android Studio interface with the following components:

- Project View:** Shows the project structure for 'DataPersistence'. The 'app' module is expanded, showing 'manifests', 'java', 'generatedJava', 'res', and 'Gradle Scripts'.
- Code Editor:** Displays the file 'com.cherwah.datapersistence\_preferences.xml' with the following XML content:

```
<?xml version="1.0" encoding="utf-8" standalone="yes" ?>
<map>
  <string name="hostname">localhost</string>
  <boolean name="echo" value="true" />
</map>
```
- Device File Explorer:** Shows the file system of the emulator 'Pixel\_2\_API\_28 Android 9, API 28'. The 'shared\_prefs' directory is expanded, showing the file 'com.cherwah.datapersistence\_preferences.xml' (158 B). A blue arrow points from this file in the Device File Explorer to the XML content in the Code Editor.
- Debugger:** Shows the 'app' module is running. The 'Frames' and 'Variables' tabs are visible, with a message 'The application is running'.
- Bottom Bar:** Includes tabs for 'Run', 'Logcat', 'TODO', 'Debug', 'Terminal', 'Build', and 'Profiler'. The status bar at the bottom shows '6:1 LF UTF-8 4 spaces'.



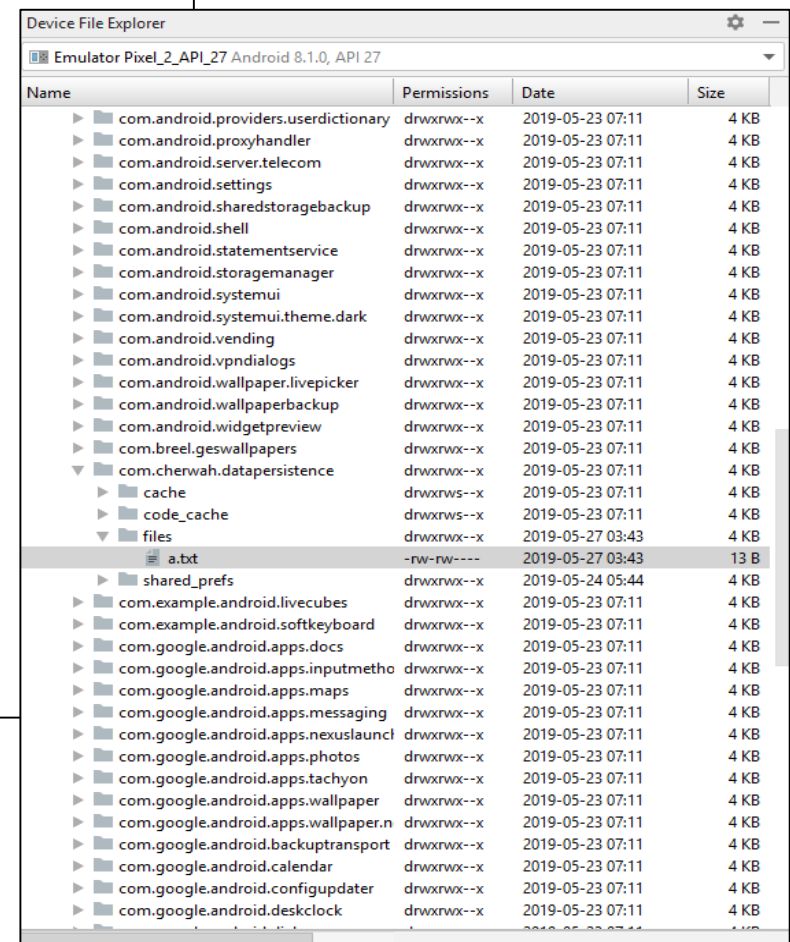
# Writing Files

- **MODE\_PRIVATE** - The created file can only be accessed by calling application

```
FileOutputStream outputStream = null;
PrintWriter writer = null;

try {
    outputStream = openFileOutput("a.txt", Context.MODE_PRIVATE);
    writer = new PrintWriter(outputStream);
    writer.println("Android 101\n");
} catch (Exception e) {
    e.printStackTrace();
} finally {
    if (writer != null)
        writer.close();

    if (outputStream != null)
    {
        try {
            outputStream.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```



Name	Permissions	Date	Size
com.android.providers.userdictionary	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.proxyhandler	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.server.telecom	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.settings	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.sharedstoragebackup	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.shell	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.statementservice	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.storagemanager	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.systemui	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.systemui.theme.dark	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.vending	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.vpndialogs	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.wallpaper.livpicker	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.wallpaperbackup	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.widgetpreview	drwxrwx--x	2019-05-23 07:11	4 KB
com.breel.geswallpapers	drwxrwx--x	2019-05-23 07:11	4 KB
com.cherwah.datapersistence	drwxrwx--x	2019-05-23 07:11	4 KB
cache	drwxrws--x	2019-05-23 07:11	4 KB
code_cache	drwxrws--x	2019-05-23 07:11	4 KB
files	drwxrwx--x	2019-05-27 03:43	4 KB
a.txt	-rw-rw----	2019-05-27 03:43	13 B
shared_prefs	drwxrwx--x	2019-05-24 05:44	4 KB
com.example.android.livecubes	drwxrwx--x	2019-05-23 07:11	4 KB
com.example.android.softkeyboard	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.docs	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.inputmetho	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.maps	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.messaging	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.nexuslaunc	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.photos	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.tachyon	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.wallpaper	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.wallpaper.n	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.backuptransport	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.calendar	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.configupdater	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.deskclock	drwxrwx--x	2019-05-23 07:11	4 KB





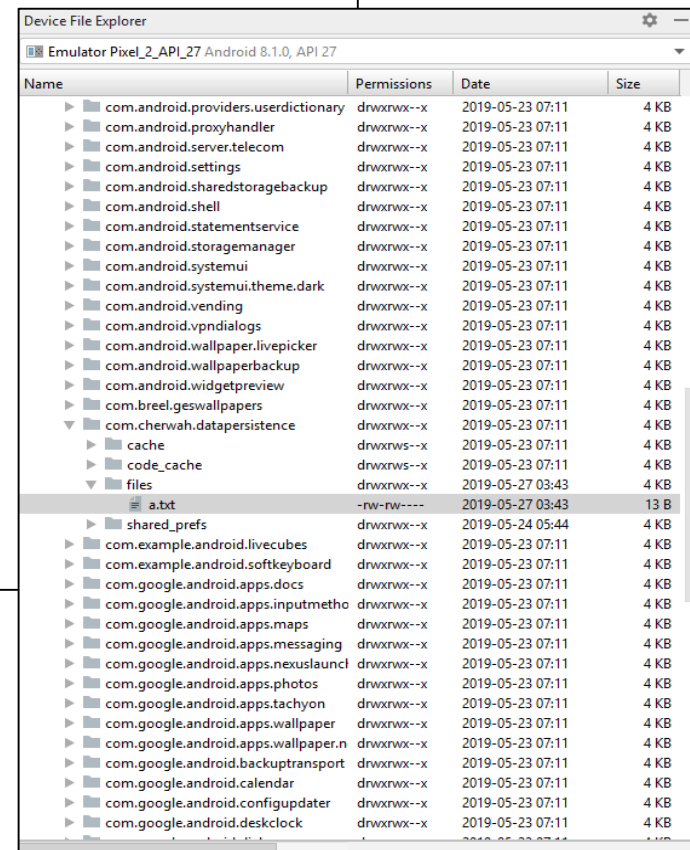
# Reading Files

```
StringBuilder strBuilder = new StringBuilder();
FileInputStream inputStream = null;
BufferedReader reader = null;

try {
    inputStream = openFileInput("a.txt");
    reader = new BufferedReader(new InputStreamReader(inputStream));

    String str;
    while ((str = reader.readLine()) != null)
        strBuilder.append(str);
} catch (Exception e) {
    e.printStackTrace();
} finally {
    try {
        if (reader != null)
            reader.close();

        if (inputStream != null)
            inputStream.close();
    } catch (IOException e) {
        e.printStackTrace();
    }
}
```



Name	Permissions	Date	Size
com.android.providers.userdictionary	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.proxyhandler	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.server.telecom	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.settings	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.sharedstoragebackup	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.shell	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.statementservice	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.storagemanager	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.systemui	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.systemui.theme.dark	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.vending	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.vpndialogs	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.wallpaper.livepicker	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.wallpaperbackup	drwxrwx--x	2019-05-23 07:11	4 KB
com.android.widgetpreview	drwxrwx--x	2019-05-23 07:11	4 KB
com.breeel.geswallpapers	drwxrwx--x	2019-05-23 07:11	4 KB
com.cherwah.datapersistence	drwxrwx--x	2019-05-23 07:11	4 KB
cache	drwxrws--x	2019-05-23 07:11	4 KB
code_cache	drwxrws--x	2019-05-23 07:11	4 KB
files	drwxrwx--x	2019-05-27 03:43	4 KB
a.txt	-rw-rw----	2019-05-27 03:43	13 B
shared_prefs	drwxrwx--x	2019-05-24 05:44	4 KB
com.example.android.livecubes	drwxrwx--x	2019-05-23 07:11	4 KB
com.example.android.softkeyboard	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.docs	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.inputmetho	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.maps	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.messaging	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.nexuslauncl	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.photos	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.tachyon	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.wallpaper	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.apps.wallpaper.n	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.backuptransport	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.calendar	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.configupdater	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.deskclock	drwxrwx--x	2019-05-23 07:11	4 KB



# Writing / Reading external storage

- Writing/reading external storage differ only in path name **/mnt/sdcard/**
  - **getExternalStorageDirectory()**
  - **getExternalStorageState()**
- Specify **WRITE\_EXTERNAL\_STORAGE** permission in **AndroidManifest.xml**
- Request for **Runtime** permission as well



# Writing / Reading external storage

```
String[] permissions = new String[] {  
    Manifest.permission.WRITE_EXTERNAL_STORAGE  
};
```

```
File file = Environment.getExternalStorageDirectory();  
String path = file.getAbsolutePath() + "/a.txt";
```

```
int requestCode = 1;  
ActivityCompat.requestPermissions(MainActivity.this,  
    permissions, 1);
```

```
FileWriter writer = null;  
try {  
    writer = new FileWriter(path, true);  
    writer.write("Android 101\n");  
} catch (Exception e) {  
    System.out.println(e.toString());  
} finally {  
    if (writer != null) {  
        try {  
            writer.close();  
        } catch (IOException e) {  
            e.printStackTrace();  
        }  
    }  
}
```

Name	Permissi...	Date	Size
com.google.android.tts	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.vide	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.web	drwxrwx--x	2019-05-23 07:11	4 KB
com.google.android.yout	drwxrwx--x	2019-05-23 07:11	4 KB
com.ustwo.lwp	drwxrwx--x	2019-05-23 07:11	4 KB
jp.co.omronsoft.openwnr	drwxrwx--x	2019-05-23 07:11	4 KB
org.chromium.webview_s	drwxrwx--x	2019-05-23 07:11	4 KB
local	drwxrwx--x	2019-05-23 07:11	4 KB
dev	drwxr-xr-x	2019-05-23 07:11	1.3 KB
etc	lrwxrwxrwx	1970-01-01 00:00	11 B
mnt	drwxr-xr-x	2019-05-23 07:11	220 B
appfuse	drwx--x--x	2019-05-23 07:11	40 B
expand	drwxrwx--x	2019-05-23 07:11	40 B
obb	drwxr-xr-x	2019-05-23 07:11	40 B
runtime	drwx-----	2019-05-23 07:11	100 B
sdcard	lrwxrwxrwx	2019-05-23 07:11	21 B
Alarms	drwxrwx--x	2019-05-23 07:11	4 KB
Android	drwxrwx--x	2019-05-23 07:11	4 KB
DCIM	drwxrwx--x	2019-05-23 07:11	4 KB
Download	drwxrwx--x	2019-05-23 07:11	4 KB
Movies	drwxrwx--x	2019-05-23 07:11	4 KB
Music	drwxrwx--x	2019-05-23 07:11	4 KB
Notifications	drwxrwx--x	2019-05-23 07:11	4 KB
Pictures	drwxrwx--x	2019-05-23 07:11	4 KB
Podcasts	drwxrwx--x	2019-05-23 07:11	4 KB
Ringtones	drwxrwx--x	2019-05-23 07:11	4 KB
a.txt	-rw-rw----	2019-05-27 05:54	40 B
secure	drwx-----	2019-05-23 07:11	60 B
user	drwxr-xr-x	2019-05-23 07:11	60 B
oem	drwxr-xr-x	1970-01-01 00:00	40 B
proc	dr-xr-xr-x	2019-05-23 07:11	0 B
root	drwx-----	2018-01-09 20:31	40 B
sbin	drwxr-x---	1970-01-01 00:00	100 B
sdcard	lrwxrwxrwx	1970-01-01 00:00	21 B
storage	drwxr-xr-x	2019-05-23 07:11	80 B
sys	dr-xr-xr-x	2019-05-23 07:11	0 B
system	drwxr-xr-x	1970-01-01 00:00	4 KB
var	lrwxrwxrwx	2019-05-23 07:11	9 B
vendor	drwxr-xr-x	1970-01-01 00:00	4 KB
bugreports	lrwxrwxrwx	1970-01-01 00:00	50 B



- Requires **android.permission.INTERNET**
- **NetworkOnMainThreadException** if network operations are performed on the UI thread – create a new Thread instead

```
new Thread(new Runnable() {  
    @Override  
    public void run() {  
        try {  
            StringBuilder b = new StringBuilder();  
            URL u = new URL("http://www.google.com/search?q=android%20httpclient");  
            HttpURLConnection conn = (HttpURLConnection) u.openConnection();  
            conn.setRequestMethod("GET");  
            conn.connect();  
  
            InputStream ins = conn.getInputStream();  
            BufferedReader rd = new BufferedReader(new InputStreamReader(ins));  
            String line;  
            while ((line = rd.readLine()) != null) {  
                b.append(line);  
                b.append('\n');  
            }  
        } catch (Exception e) {  
            System.out.println(e.toString());  
        }  
    }  
}).start();
```



# Active Recall

`/mnt/sdcard`  
`getExternalStorageDirectory`  
`/data/data/<app>`  
`getExternalStorageState`  
**Shared Preferences**  
**requestPermissions**  
`android.permission.INTERNET`  
`WRITE_EXTERNAL_STORAGE`