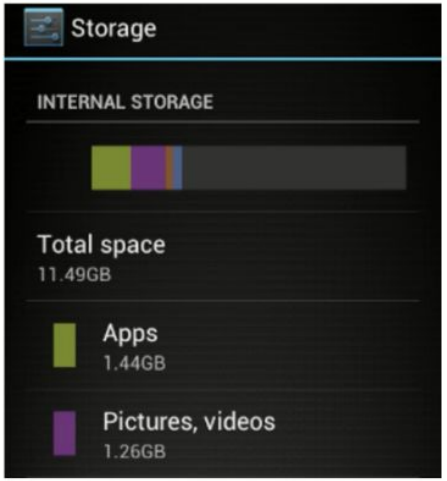
Files

Lecture 5

Files and Storage

Android can read/write files from two locations: **internal** and **external** storage. Both are **persistent**; data remains after power-off / reboot.

- **internal storage**: Built into the device.
- **external storage**: An SD card or other drive attached to device.
- An app can typically be installed into either area.



Internal Storage

internal storage: Built into the device.

- guaranteed to be present
- typically smaller (~4-8 gb)
- can't be expanded or removed
- specific and private to each app
- wiped out when the app is uninstalled
- more secure; visible only to a given app and user
- To put an input file into your app's internal storage, place it in the **res/raw** folder.

External Storage

external storage: An SD card or other drive attached to device.

- may not be present, depending on the device
- can be removed or transferred to another device if needed
- visible to other apps and users
- read/writable by other apps and users; not private to your app
- not wiped when the app is uninstalled, except in certain cases

Files and Streams

- `File` - Objects that represent a file or directory.
  - methods: canRead, canWrite, create, delete, exists, getName, getParent, getPath, isFile, isDirectory, lastModified, length, listFiles, mkdir, mkdirs, renameTo
- `InputStream`, `OutputStream` - flows of data bytes from/to a source or destination
  - Could come from a file, network, database, memory, ...
  - Normally not directly used; they only include low-level methods for reading/writing a byte (character) at a time from the input.
  - Instead, a stream is often passed as parameter to other objects like a Scanner, java.io.BufferedReader, java.io.PrintStream to do the actual reading / writing.

Scanner Class

Method	Description

`new Scanner(InputStream)`
`new Scanner(File)`
`new Scanner(String)`
	open a scanner to read from a stream, file, or to tokenize the words of a string

`close()`	shuts down scanner and stops reading
`hasNext()`	true if there are more tokens
`hasNextDouble()`	true if there is a next token and it's a double
`hasNextInt()`	true if there is a next token and it's an int
`hasNextLine()`	true if there are more lines
`String next()`	returns next word (whitespace-separated)
`nextDouble()`	returns next token as a double
`nextInt()`	returns next token as an int
`nextLine()`	returns next line (up to but excluding \n)
`useDelimiter("str")`	uses given string as separator for tokenizing

Using Internal Storage

An activity has methods you can call to read/write files:

Method	Description
`getResources().openRawResource(R.raw.id)`	read an input file from **res/raw/**
`getFilesDir()`	returns internal directory for your app
`getCacheDir()`	returns a "temp" directory for scrap files
`openFileInput("name", mode)`	opens a file for reading
`openFileOutput("name", mode)`	opens a file for writing

- You can use these to read/write files on the device.
  - many methods return standard `File` objects
  - some return `InputStream` or `OutputStream` objects, which can be used with standard classes like `Scanner`, `BufferedReader`, and `PrintStream` to read/write files

Internal Storage Example 1

```
// read a file, and put its contents into a TextView
// (assumes hello.txt file exists in res/raw/ directory)
Scanner scan = new Scanner(
        getResources().openRawResource(R.raw.hello));
String allText = "";   // read entire file
while (scan.hasNextLine()) {
    String line = scan.nextLine();
    allText += line;
}
myTextView.setText(allText);
scan.close();
```

Write a new file

```
// write a short text file to the internal storage
PrintStream output = new PrintStream
        openFileOutput("out.txt", MODE_PRIVATE));
output.println("Hello, world!");
output.println("How are you?");
output.close();
...
// read the same file, and put its contents into a TextView
Scanner scan = new Scanner(
        openFileInput("out.txt", MODE_PRIVATE));
String allText = "";   // read entire file
while (scan.hasNextLine()) {
    String line = scan.nextLine();
    allText += line;
}
myTextView.setText(allText);
scan.close();
```

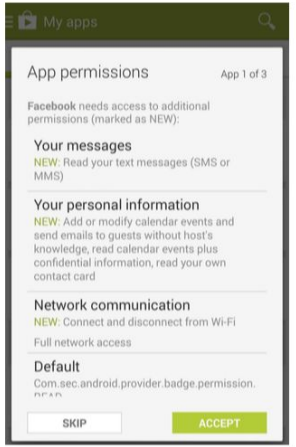
Reading an existing File

Exercise

Make an app using data from a file.

External Storage Permission

- If your app needs to read/write the device's external storage, you must explicitly request **permission** to do so in your app's **AndroidManifest.xml** file.
  - On install, the user will be prompted to confirm your app permissions.




```
<manifest ...>
    <uses-permission
     android:name="android.permission.READ_EXTERNAL_STORAGE" />
    <uses-permission
     android:name="android.permission.WRITE_EXTERNAL_STORAGE" />
    ...
</manifest>
```

Using External Storage

- Methods to read/write external storage:
  - `getExternalFilesDir("`***name***`")` - returns "private" external directory for your app with the given name
  - `Environment.getExternalStoragePublicDirectory(`***name***`)` - returns public directory for common files like photos, music, etc.
    - pass constants for ***name*** such as Environment.DIRECTORY_ALARMS, DIRECTORY_DCIM, DIRECTORY_DOWNLOADS, DIRECTORY_MOVIES, DIRECTORY_MUSIC, DIRECTORY_NOTIFICATIONS, DIRECTORY_PICTURES, DIRECTORY_PODCASTS, DIRECTORY_RINGTONES
- You can use these to read/write files on the external storage.
  - the above methods return standard java.io.**File** objects
  - these can be used with standard classes like Scanner, BufferedReader, and PrintStream to read/write files (see Java API)

External Storage Example

```
// write short data to app-specific external storage
File outDir = getExternalFilesDir(null);   // root dir
File outFile = new File(outDir, "example.txt");
PrintStream output = new PrintStream(outFile);
output.println("Hello, world!");
output.close();

// read list of pictures in external storage
File picsDir =
        Environment.getExternalStoragePublicDirectory(
                Environment.DIRECTORY_PICTURES);
for (File file : picsDir.listFiles()) {
    ...
}
```

Checking if storage is available

```
/* Checks if external storage is available
 * for reading and writing */
public boolean isExternalStorageWritable() {
    return Environment.MEDIA_MOUNTED.equals(
            Environment.getExternalStorageState());
}

/* Checks if external storage is available
 * for reading */
public boolean isExternalStorageReadable() {
    return isExternalStorageWritable() ||
            Environment.MEDIA_MOUNTED_READ_ONLY.equals(
                Environment.getExternalStorageState());
}
```

Accessing Web Data

- To read data from the web, first request the INTERNET permission in your **AndroidManifest.xml**:

```
<uses-permission
  android:name="android.permission.INTERNET" />
```

- Then you can use the standard `java.net.URL` class to connect to a file or page at a given URL and read its data:

```
URL url = new URL("http://foobar.com/example.txt");
Scanner scan = new Scanner(url.openStream());
while (scan.hasNextLine()) {
    String line = scan.nextLine();
    ...
}
```