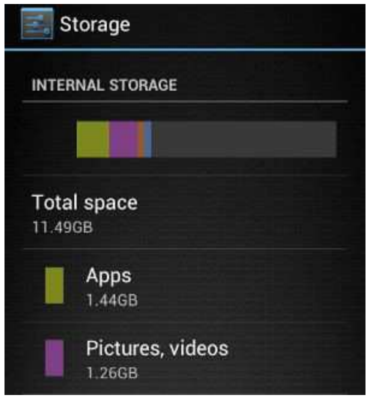
8. Data files and storage

Files and storage

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

- **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



File and Streams

- java.io.**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

- java.io.Input**Stream**, OutputStream - Stream objects represent 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 java.util.**Scanner**, java.io.**BufferedReader**, java.io.**PrintStream** to do the actual reading / writing.

Using internal storage

- An activity has methods you can call to read/write files:
  - `getFilesDir()` - returns internal directory for your app
  - `getCacheDir()` - returns a "temp" directory for scrap files
  - `getResources().openRawResource(R.raw.`***`id`***`)`
    - read an input file from `res/raw/`
  - `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 java.io.**File** objects
  - some return java.io.**InputStream** or **OutputStream** objects, which can be used with standard classes like Scanner, BufferedReader, and PrintStream to read/write files (see Java API)

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));
StringallText  = "";   // read entire file
while (scan.hasNextLine()) {
    String line = scan.nextLine();
    allText += line;
}
myTextView.setText(allText);
scan.close();
```

Internal storage example 2

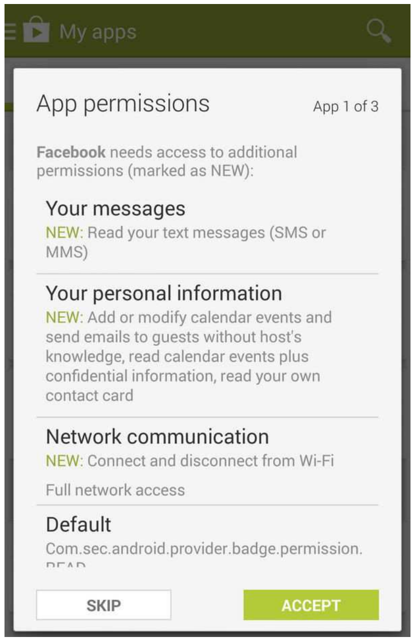
```
// write a short text file to the internal storage
PrintStream output = new PrintStream
        openFileOutput("out.txt", MODE_PRIVATE));
output.println("Hello, world!");
output.println("How areyou?");
output.close();
...
// read the same file, and put its contents into a TextView
Scanner scan =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

External storage

- **external storage**: Card that is inserted into the device. *(such as a MicroSD card)*
  - can be much larger than internal storage (~8-32 gb)
  - can be removed or transferred to another device if needed
  - may not be present, depending on the device
  - read/writable by other apps and users; not private to your app
  - *not* wiped when the app is uninstalled, except in certain cases

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.



App permissions

App 1 of 3

Facebook needs access to additional permissions (marked as NEW):

Your messages
NEW: Read your text messages (SMS or MMS)

Your personal information
NEW: Add or modify calendar events and send emails to guests without host's knowledge, read calendar events plus confidential information, read your own contact card

Network communication
NEW: Connect and disconnect from Wi-Fi
Full network access

Default
Com.sec.android.provider.badge.permission.READ

```
<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 shortdata toapp-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());
}
```