CPSC495/595
Persistence

*content adapted from http://www.cs.utexas.edu/~scottm/cs378/schedule.htm

Saving Data TEMPORARY

- Ephemeral storage.
  - System kills app – view object state saved
  - You kill app- gone forever
- Techniques
  - Widget has ID system saves state
  - Bundle or Intent (mostly for sending data to new activities or processes)
  - Application object (singleton pattern)

Saving Data TEMPORARY
Application Object (for global data)

```
public class applicationObject extends Application{

    private static final String TAG = "Application";
    private static final  int UNINITIALIZED = -1;

    private  Integer myInteger;

    public  Integer getMyInteger() {
        if (myInteger == null)
            myInteger = new Integer(UNINITIALIZED);
        return myInteger;
    }

    public  void setMyInteger(Integer myInt) {
        if (myInteger == null)
            myInteger = new Integer(myInt);
        else
            myInteger = myInt;
        //the above is the same as
        //myInteger = (myInteger == null) ?new Integer(myInt): myInt;
    }
    @Override
    public void onCreate() {
        super.onCreate();
         Log.e(TAG,"APPLICATION onCreate, myInteger=");
    }
```

Create class that derives from Application. Tracks global data. Could be authentication token, database connection
If multithreaded synchronize access

```
<application
    android:name=".applicationObject"
    android:allowBackup="true"
    android:icon="@drawable/ic_launcher"
    android:label="ApplicationObject"
    android:theme="@style/AppTheme" >
    <activity
        android:name=".MainActivity"
        android:label="ApplicationObject" >
```

Define in manifest

Finally use in all activities

```
public class MainActivity extends ActionBarActivity {
    private static final String TAG = "Mainactivity";
    TextView myView;
    applicationObject myObject;

    private static final  int RES2 = 0;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        Log.d(TAG,"MainActivity onCreate");

        myObject = (applicationObject)getApplication();
        myView= (TextView)findViewById(R.id.textView2);
        myView.setText("Application myInteger =" + Integer.toString(myObject.getMyInt
    }
    public void doClickButton2(View view) {
        myObject.setMyInteger( myObject.getMyInteger()+1);
        myView.setText("Application myInteger =" + Integer.toString(myObject.getMyInt
    }
```

Saving Data PERMANENT

- Shared Preferences- private data stored in key-value pairs
- Internal Storage - private data on the device
- External Storage – public data on the device
- SQLite Database (we will not do)
- Cloud (we will probably not do)

Shared Preferences

- SharedPreferences Class
- Store and retrieve key-value pairs of data
  - keys are Strings
  - values are Strings, Sets of Strings, boolean, float, int, or long (like a bundle)
- Can save any data this way as long as its Parcelable (Serializable)

Writing to SharedPreferences Recipe

- Obtain SharedPreferences object:
- Call edit() method on object to get a SharedPreferences.Editor object
- Insert data by calling put methods on the SharedPreferences.Editor object (Int, Boolean,String char etc)
- Commit changes

Writing to SharedPreferences

```
private static final String PREF_FILE_NAME  = "PrefFile";
private static final String PASSWORD        = "Password";
private static final String DEFAULT_PWD     = "Default";

public void savePref() {
    //SHAREDPREFERENCES - PERMANENT STORAGE
    // get a handle to "PrefFile", create if necessary, only this
    // process has access can have MODE_WORLD_READABLE and MODE_WORLD_WRITEABLE. S
    SharedPreferences settings = getSharedPreferences("PrefFile",MODE_PRIVATE);

    // can only make changes with editor
    SharedPreferences.Editor editor = settings.edit();

    // slap something in it, strings, booleans ints, check the docs
    editor.putString(PASSWORD, "admin");

    //editor.clear();          //removes everthing
    //editor.remove(PASSWORD); //dumps key value pair

    // Commit the edits! You dont call this it aint saved!
    editor.commit();
}
```

Defaults

choose file

must edit()

save values

can clear all
or delete one

must commit

Reading From Shared Preferences recipe

- Provide key (string) and default value if key is not present
- get Boolean, Float, Int, Long, String, StringSet

Reading from SharedPreferences

```
private static final String PREF_FILE_NAME  = "PrefFile";
private static final String PASSWORD        = "Password";
private static final String DEFAULT_PWD     = "Default";
public void getPref(){
    //SHAREDPREFERENCES - PERMANENT STORAGE
    // Restore preferences
    SharedPreferences settings = getSharedPreferences(PREF_FILE_NAME,MODE_PRIVATE);
    String savedPwd = settings.getString(PASSWORD, DEFAULT_PWD);
}
```

Defaults

choose file

get value

Shared Preferences File

- Stored as XML
- Stored on emulated device data/data/<yourpackagename>…

```
<?xml version="1.0" encoding="UTF-8" standalone="
<map>
    <string name="Password">admin</string>
</map>
```

Internal Storage - Examples

- See 5_Serialization on github

Internal Storage

- Private data stored on device memory
- More like traditional file i/o
- by default files are private to your application
  - other apps cannot access
- files removed when app is uninstalled

Internal Storage - Reading

```
public void doGet(View v) {
    FileInputStream fis = null;
    Scanner scanner = null;
    StringBuilder sb = new StringBuilder();
    try {
        fis = openFileInput(FILENAME);
        scanner = new Scanner(fis);
        try {
            while (scanner.hasNextLine()) {
                sb.append(scanner.nextLine());
            }
        } finally {
            if (fis != null) {
                try {
                    fis.close();
                } catch (IOException e) {
                    //why bother?
                }
            }
            if (scanner != null) {
                scanner.close();
            }
            et.setText(sb.toString());
            setFileLoc();
        }

    } catch (FileNotFoundException e) {
        Log.e(TAG, "File not found", e);
    }
}
```

Build the string

Close Input Stream

Close scanner

Set the EditText

Internal Storage - Writing

```
public void doSave(View v) {
    String data = et.getText().toString();

    FileOutputStream fos = null;
    try {
        // note that there are many modes you can use
        fos = openFileOutput(FILENAME, Context.MODE_PRIVATE);
        try {
            fos.write(data.getBytes());
        } finally {
            fos.close();
            et.setText("");
            setFileLoc();
        }
    } catch (FileNotFoundException e) {
        Log.e(TAG, "File not found", e);
    } catch (IOException e) {
        Log.e(TAG, "IO problem", e);
    }
}
```

Get text from EditText

Private

```
private void setFileLoc() {
    etLocation.setText(this.getFilesDir().getAbsolutePath());
    etFileName.setText(FILENAME);
}
```

External Files - Other Useful Methods

- All of these are inherited from Context
- File getFileDir()
  - get absolute path to filesystem directory when app files are saved
- File getDir(String name, int mode)
  - get and create if necessary a directory for files
- boolean deleteFile(String name)
  - get rid of files, especially cache files
- String[] fileList()
  - get an array of Strings with files associated with Context (application)

Static Files

- If you need / have a file with a lot of data at compile time:
  - save file in project res/raw directory
  - can open file using the openRawResource(int id) method and pass the R.raw.*id* of file
  - returns an InputStream to read from file
  - cannot write to the file

External Storage - Examples

- See 5_Serialization on github

External Storage

- Public data stored on shared external storage
- are world-readable if use
  - getExternalStoragePublicDirectory()
- are private if use
  - getExternalFilesDir()

But you need Permission
(for external storage only)

- < uses-permission>, need to use certain device capabilities, such as accessing the Internet, SMS etc

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.demopreferences"
    android:versionCode="1"
    android:versionName="1.0" ><uses-sdk
        android:minSdkVersion="19"
        android:targetSdkVersion="19" />

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

    <application
```

Checking Media Availability

- Environment.getExternalStorageState() determines if media available
  - may be mounted to computer, missing, read-only or in some other state that prevents accessing

Checking Media Availability

```
boolean mExternalStorageAvailable = false;
boolean mExternalStorageWriteable = false;
String state = Environment.getExternalStorageState();

if (Environment.MEDIA_MOUNTED.equals(state)) {
    // We can read and write the media
    mExternalStorageAvailable = mExternalStorageWriteable = true;
} else if (Environment.MEDIA_MOUNTED_READ_ONLY.equals(state)) {
    // We can only read the media
    mExternalStorageAvailable = true;
    mExternalStorageWriteable = false;
} else {
    // Something else is wrong. It may be one of many other states,
    //  to know is we can neither read nor write
    mExternalStorageAvailable = mExternalStorageWriteable = false;
}
```

Get state from Environment

available

Read

Cannot Use

External File Directory (private to your app)

- Used only by your app (textures, sounds)
- External files associated with application are deleted when application uninstalled

```
File file = new File(getExternalFilesDir(null), "DemoFile.jpg");
```

If any of the following
DIRECTORY_ALARMS,
DIRECTORY_MUSIC,
DIRECTORY_PICTURES,
Etc
specific subdirectory created

External Shared Files

- Files shared with other apps
- Use public directories on the external storage device
- Not deleted when app uninstalled
- getExternalStoragePublicDirectory(String type)
- Type is DIRECTORY_ALARMS, DIRECTORY_DCIM (Digital Camera IMages), DIRECTORY_DOWNLOADS, DIRECTORY_MOVIES, DIRECTORY_MUSIC, DIRECTORY_NOTIFICATIONS, DIRECTORY_PICTURES, DIRECTORY_PODCASTS, DIRECTORY_RINGTONES
- System media scanner will categorize your files based on this type

Summary

- Review of temp storage (widget with ID, bundle, application object)
- SharedPreferences
- Internal and External Storage
- Permission intro

Next time - In Class Example

- A calculator that shares its results via email. Illustrates, intents, bundles, preferences.
- See github

Soon - Preference Activity

- An Activity framework to allow user to select and set preferences for your app
- Main Activity can start a preference activity to allow user to set preferences
- Much like the preferences we have done except calls

  getDefaultSharedPreferences(this)
- Boilerplate professional code
- We will do these after we do Fragments