



## G2 - Android Programming

*Programming applications for the Android platform*

### Objectives

- Discover the Android system architecture.
- Understand the Android SDK and NDK
- Master Android application architecture
- Master the main programming tasks with Android
  - designing user interfaces
  - data storage and retrieval
  - network communications...
- Integrating your application in an Android system
  - calling system components
  - being callable by other components

Labs are conducted on i.MX6 or i.MX8 boards

We use the last open source version of Android, as available on the board.

### Who should attend this course

- Engineers that must create programs for the Android platform

### Prerequisite

- Advanced knowledge of Java programming (see our [L4G - Java for Android](#) course)

### Course environment

- Printed course material (in English).
- A Linux or Windows PC and an Android target for each group of 2 trainees.
- Documentation and exercise solutions.

### Target Audience

- Any embedded systems engineer or technician with the above prerequisites.

## Course Outline

### First Day

#### Introduction

- History
- Overview
- The Android system architecture
  - Android services
  - Android frameworks

#### Android application architecture

- Structure of an Android Application
- Android application components
  - Activity
  - Service
  - Broadcast receiver
  - Content provider
- Manifest file
  - Application components declaration
  - Permissions

**Exercise:** Hello world application

## Activities and user interface

- Activities life cycle
- Activity callbacks
  - onCreate
  - onStart
- Intents and Intents filter
  - the Intent class
  - declaring Intent filters in manifest files
- Activity invocation with and without results
  - startActivity
  - startActivityForResult
- Tasks (activities stack) and navigation between activities
- Resources
  - Strings
  - images
  - layouts...
- Views
  - Buttons, labels and edition fields
  - View instantiation from a resource
- Layouts
  - Layout kinds
  - Components properties related to layouts
- Specialized views
  - ListView
  - Data binding (Adapter class and subclasses)

**Exercise:** The simplified Notepad application

## Second Day

### User Interactions

- User Input
  - Touch screen and keyboard
  - Software keyboard management
- User notifications
  - Dialog box
  - Status Bar
  - Toast
  - The Search dialog (SearchManager)
- Notifications and the Notification Manager
  - Notifications in the Status bar
  - Vibrating or flashing
- Push notifications

**Exercise:** Enhancing the Notepad application

- User interface adaptation

- Depending on the language
- Depending on screen characteristics (dimensions, orientation &)

**Exercise:** Bilingual Hello world (English-French)

## Test and debug

- Using the debugger from Eclipse
- Logs
- Unit testing

## Advanced User Interface

- User interface and multithreading
  - Accessing views from another thread

**Exercise:** Multi-threaded user interface with buttons and progress bars

- Custom control creation
  - By deriving directly the View class
  - By deriving an existing view
- 2D Drawing
  - Canvas and Shapes
  - Drawing from the main thread
  - Drawing from another thread
- Animations

**Exercise:** Moving an image on the screen

## Third day

### The Fragment API

- What is a fragment
- The fragment lifecycle
  - Interaction with the Activity lifecycle
  - The fragment-specific lifecycle callbacks
- Fragments and screen orientation
  - Using fragment to adapt to various screen sizes
  - Reacting to orientation changes
- The various specialized fragments
  - List fragments
  - Dialog fragments

**Exercise:** Adapting the Notepad application to varying screen sizes using fragments

### The Android NDK

- The Android NDK
  - Defining Java methods in C++
  - JNI for Android
  - Using SWIG
- Integrating native code in a package
  - Using the NDK from Eclipse
  - Debugging native code

### OpenGL/ES

- OpenGL and OpenGL/ES
  - OpenGL/ES versions
  - Java Access to OpenGL/ES
  - Native access using the NDK

- Base Concepts
  - Vertices and Triangles
  - Transformation
  - Drawing
- OpenGL/ES 1.1
  - The OpenGL/ES 1.1 Pipeline
  - Projection and Camera View
- OpenGL/ES 2.0
  - The OpenGL/ES 2.0 programmable pipeline
  - Vertex shaders
  - Fragment shaders
  - Applying transforms
- Android OpenGL Setup

**Exercise:** Creating an animated 3D view in OpenGL/ES (from Java and through the NDK)

## Renderscript

- The Android Renderscript layer
  - The Android framework renderscript API
  - The Reflected layer mapping renderscript code to Java classes
- Renderscript code
  - The Renderscript C language
  - The renderscript compute engine
  - The deprecated renderscript graphics engine

**Exercise:** Using Renderscript compute for transforming an image from color to black and white

## Fourth Day

### Services

- Service declaration
- Starting and stopping a service
- RPC
  - Definition and implementation of an AIDL interface
  - Service binding and RPC invocation
- The Android binder

**Exercise:** Creation of an application service

- System services
  - What is a system service
  - Static and context-dependent services
  - Structure of a system service
  - The ServiceManager process
- Application Power Management

**Exercise:** Use Android Power Management to prevent device getting asleep

### Multimedia

- Audio and video playback (MediaPlayer class)
- Audio and video capture (MediaRecorder class)

**Exercise:** Implementation of an mp3 playback service

### Broadcast Receivers

- Installing a Broadcast Receiver
  - Static creation of broadcast receivers
  - Dynamic instantiation and registration
- Broadcasting intents

- Normal broadcast
- Ordered broadcast
- Using PendingIntent in broadcast receivers
- System broadcasted events

**Exercise:** Implementation of a custom broadcast receiver

## Network

- Connections management
- Sockets
- HTTP requests
- WebView control
- Web Services

**Exercise:** Socket communications

**Exercise:** Displaying a web page with a WebView

**Exercise:** Consuming a web service

## Fifth Day

### Data management

- Storage
  - Shared preferences
  - Internal storage
  - External storage
  - SQLite
- Content provider
  - Communication with a content provider
  - Implementing a content provider

**Exercise:** MP3 file storage alongside author and album names in a SQLite table

**Exercise:** Implementation of a content provider and a client to retrieve the MP3 files

### Interacting with the platform

- Contacts management
- Sending and receiving emails
- Placing a phone call
- Camera, video and still Pictures
- Main system events
- Broadcasted events

**Exercise:** Application to take a picture and send it to a contact

### The Android Sensors

- Sensors in Android
  - The sensor types
  - The Sensor Manager
  - Accessing Sensors
- Framework Architecture
  - Sensor discovery
  - Sensor Calibration

**Exercise:** Getting and displaying a sensor value (temperature...)

### Bluetooth

- Configuration
- Device search

- Services management (SDP)
- RFCOMM sockets

**Exercise:** Bluetooth chat

## Location and Google Map API

- Location
  - Location framework with cells, WIFI or GPS
  - The LocationManager class
- Integrating Google Map API in an application
  - The MapView class

**Exercise:** Using a MapView and displaying an image in it for points of interest