



# Lecture 01: Touch & Input

## IN721: Design and Development of Applications for Mobile Devices

### Semester One, 2020

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Te Kura Matatini ki Otago, Ōtepoti, Aotearoa

Wednesday, 19 February

# ADMINISTRATION

- ▶ Click [here](#) to download the **course directive**
- ▶ Click [here](#) to view the **course materials repository**. Please clone this repository

# LECTURE 01: TOUCH & INPUT TOPICS

- ▶ Brief History
- ▶ Linux Kernel
- ▶ Software Stack
- ▶ Open-Source Community
- ▶ QEMU
- ▶ Kotlin
- ▶ Android Studio
- ▶ ArrayAdapter
- ▶ Inner class

## BRIEF HISTORY

- ▶ Founded in Palo Alto, California in October 2003
- ▶ Early intentions were to develop an advanced operating system for digital cameras
- ▶ Google acquired Android Inc in July 2005
- ▶ Developed by a group of developers known as the Open Handset Alliance (OHA)
- ▶ De facto software for numerous smartphone manufacturing companies

# BRIEF HISTORY

- ▶ Mascot of Android is a green robot
- ▶ Designed by Irina Blok on November 5, 2007 when Android was announced
- ▶ No official name, though the Android team at Google call it **Bugdroid**
- ▶ One of most recognisable icons in the technology world



# LINUX KERNEL

- ▶ Based on the Linux kernel's LTS branches
- ▶ Android targets versions 4.14, 4.4 & 4.9 of the Linux kernel
- ▶ A Linux distribution according to the Linux Foundation

# SOFTWARE STACK

- ▶ Application
- ▶ Application framework
- ▶ Libraries
- ▶ Android runtime
- ▶ Hardware abstraction layer
- ▶ Linux kernel

# OPEN-SOURCE COMMUNITY

- ▶ Android's source code is released by Google under an open-source license



# MARKET SHARE

- ▶ Android - 74.3%
- ▶ iOS - 24.76%
- ▶ Reference - [StatCounter \(Mobile OS Market Share\)](#)

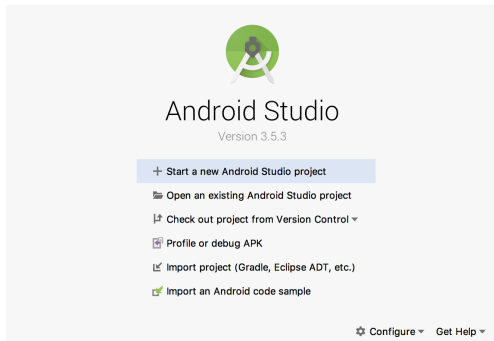
# QEMU

- ▶ Quick EMUlator
- ▶ Open-source competitor to VMware Workstation, VirtualBox, HyperV
- ▶ Android emulator is built on top of the QEMU emulator

# KOTLIN

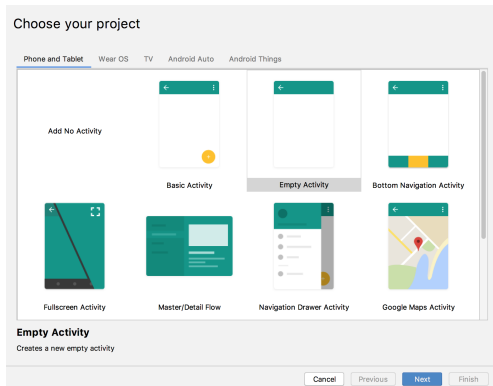
- ▶ Cross-platform
- ▶ Statically typed
- ▶ Type inference
- ▶ Interoperable with Java
- ▶ Preferred programming language for Android application developers
- ▶ One of my favourite programming languages

# ANDROID STUDIO: APPLICATION SETUP



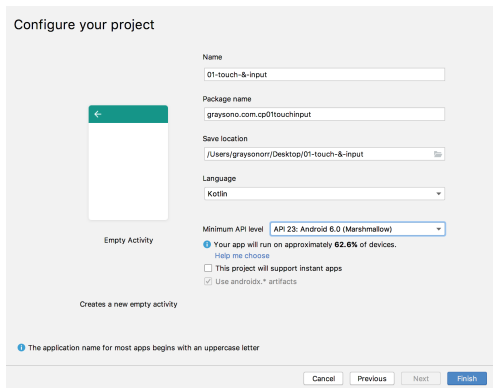
# ANDROID STUDIO: APPLICATION SETUP

- ▶ Choosing a project
  - ▶ Basic activity
  - ▶ Empty activity
  - ▶ Bottom navigation activity



# ANDROID STUDIO: APPLICATION SETUP

- ▶ Configuring a project
  - ▶ Name
  - ▶ Package name
  - ▶ Save location
  - ▶ Language
  - ▶ Minimum API level



The screenshot shows the 'Configure your project' dialog in Android Studio. On the left, there is a preview of an 'Empty Activity' with a green header bar and a white body. Below the preview, it says 'Creates a new empty activity'. On the right, there are several input fields and a dropdown menu:

- Name:** 01-touch-&-input
- Package name:** graysono.com.cp01touchinput
- Save location:** /Users/graysonrr/Desktop/01-touch-&-input
- Language:** Kotlin (selected from a dropdown)
- Minimum API level:** API 23: Android 6.0 (Marshmallow) (selected from a dropdown)

Below the 'Minimum API level' dropdown, there is a blue information icon followed by the text: 'Your app will run on approximately 62.6% of devices.' Below this, there is a link 'Help me choose'. Below that, there are two checkboxes:

- ☐ This project will support instant apps
- ☒ Use androidx.\* artifacts

At the bottom of the dialog, there is a blue information icon followed by the text: 'The application name for most apps begins with an uppercase letter'. At the very bottom, there are four buttons: 'Cancel', 'Previous', 'Next', and 'Finish'.

# ANDROID STUDIO: APPLICATION SETUP

- ▶ Android platform version
- ▶ Cumulative distribution

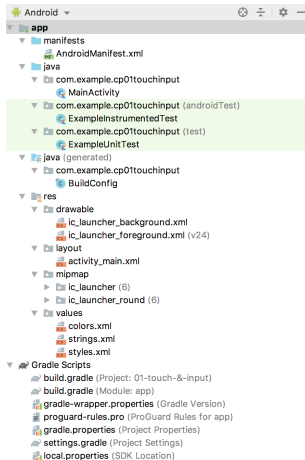
ANDROID PLATFORM VERSION	API LEVEL	CUMULATIVE DISTRIBUTION	Marshmallow	
4.0 Ice Cream Sandwich	15		<b>Security</b> Fingerprint Authentication Confirm Credential  <b>System</b> App Linking Adoptable Storage Devices  <b>Multimedia</b> 4K Display Mode Support for MIDI Create digital audio capture and playback objects APIs to associate audio and input devices List of all audio devices Updated video processing APIs Flashlight API Reprocessing Camera2 API Updated ImageWriter objects and ImageReader class  <b>User Input</b> Voice Interactions Assist API Bluetooth Stylus Support	<b>User Interface</b> Themeable ColorStateLists  <b>Wireless &amp; Connectivity</b> Hotspot 2.0 Improved Bluetooth Low Energy Scanning  <b>Android for Work</b> Controls for Corporate-Owned, Single-Use devices Silent install and uninstall of apps by Device Owner Silent enterprise certificate access Auto-acceptance of system updates Delegated certificate installation Data usage tracking Runtime permission management Work status notification
4.1 Jelly Bean	16	99.6%		
4.2 Jelly Bean	17	98.1%		
4.3 Jelly Bean	18	95.9%		
4.4 KitKat	19	95.3%		
5.0 Lollipop	21	85.0%		
5.1 Lollipop	22	80.2%		
6.0 Marshmallow	23	62.6%		
7.0 Nougat	24	37.1%		
7.1 Nougat	25	14.2%		
8.0 Oreo	26	6.0%		
8.1 Oreo	27	1.1%		

<https://developer.android.com/about/versions/marshmallow/android-6.0.html>

Cancel OK

# ANDROID STUDIO: APPLICATION SETUP

## ► Directory structure





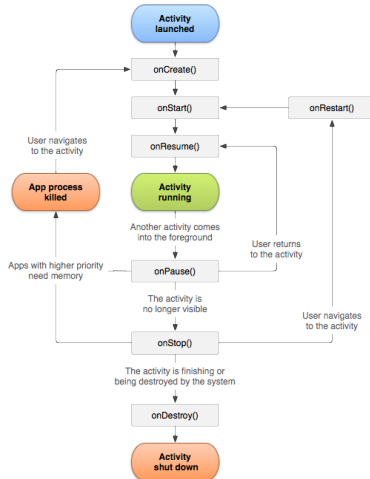
# ANDROID STUDIO: MainActivity.KT

- ▶ AppCompatActivity
- ▶ Activity lifecycle - onCreate()

A screenshot of the Android Studio code editor showing the MainActivity.kt file. The code is written in Kotlin and defines the MainActivity class, which inherits from AppCompatActivity. It includes imports for AppCompatActivity and Bundle, and overrides the onCreate method to call super.onCreate and setContentView.

```
1 package com.example.cp01touchinput
2
3 import androidx.appcompat.app.AppCompatActivity
4 import android.os.Bundle
5
6 class MainActivity : AppCompatActivity() {
7
8     override fun onCreate(savedInstanceState: Bundle?) {
9         super.onCreate(savedInstanceState)
10        setContentView(R.layout.activity_main)
11    }
12 }
13
```

# ANDROID STUDIO: ACTIVITY LIFECYCLE



# INNER CLASS

- ▶ Interface - OnClickListener
- ▶ android.view.View.OnClickListener
- ▶ A callback to be invoked when a view is clicked
- ▶ Public methods - onClick(v: View!): Unit

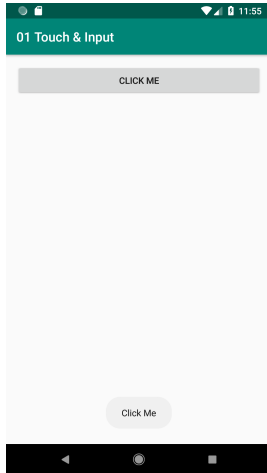
```
MainActivity.kt x
1 package com.example.cp01touchinput
2
3 import androidx.appcompat.app.AppCompatActivity
4 import android.os.Bundle
5 import android.view.View
6 import android.widget.Toast
7 import kotlinx.android.synthetic.main.activity_main.*
8
9 class MainActivity : AppCompatActivity() {
10
11     override fun onCreate(savedInstanceState: Bundle?) {
12         super.onCreate(savedInstanceState)
13         setContentView(R.layout.activity_main)
14         btnClick.setOnClickListener(ButtonOnClickListener())
15     }
16
17     inner class ButtonOnClickListener : View.OnClickListener {
18         override fun onClick(view: View?) {
19             Toast.makeText(context: this@MainActivity, text: "Click Me", Toast.LENGTH_LONG).show()
20         }
21     }
22 }
```

# ALTERNATIVE TO INNER CLASS

## ► Simplified

```
MainActivity.kt x
1 package com.example.cp01touchinput
2
3 import androidx.appcompat.app.AppCompatActivity
4 import android.os.Bundle
5 import android.view.View
6 import android.widget.Toast
7 import kotlinx.android.synthetic.main.activity_main.*
8
9 class MainActivity : AppCompatActivity() {
10
11     override fun onCreate(savedInstanceState: Bundle?) {
12         super.onCreate(savedInstanceState)
13         setContentView(R.layout.activity_main)
14         btnClick.setOnClickListener(View.OnClickListener { it: View!
15             Toast.makeText(context: this@MainActivity, text: "Click Me", Toast.LENGTH_LONG).show()
16         })
17     }
18 }
```

# EMULATOR - ONCLICKLISTENER



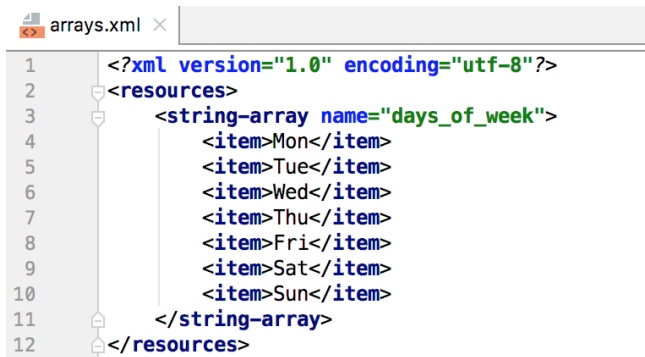
# ARRAYADAPTER

## ► arrayOf - Kotlin

```
MainActivity.kt x
1 package com.example.cp01touchinput
2
3 import androidx.appcompat.app.AppCompatActivity
4 import android.os.Bundle
5 import android.widget.ArrayAdapter
6 import android.widget.Spinner
7 import kotlinx.android.synthetic.main.activity_main.*
8
9 class MainActivity : AppCompatActivity() {
10
11     override fun onCreate(savedInstanceState: Bundle?) {
12         super.onCreate(savedInstanceState)
13         setContentView(R.layout.activity_main)
14         val daysOfWeek = arrayOf("Mon", "Tue", "Wed", "Thu", "Fri", "Sat", "Sun")
15         populateSpinner(spnDaysOfWeek, daysOfWeek)
16     }
17
18     private fun populateSpinner(spinner: Spinner, array: Array<String>) {
19         val layoutID: Int = android.R.layout.simple_spinner_item
20         spinner.adapter = ArrayAdapter(context: this@MainActivity, layoutID, array)
21     }
22 }
```

# ALTERNATIVE TO ARRAYOF

- ▶ arrays.xml
- ▶ values > New > Values resource file



The screenshot shows an XML editor window titled 'arrays.xml'. The XML code is as follows:

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <resources>
3   <string-array name="days_of_week">
4     <item>Mon</item>
5     <item>Tue</item>
6     <item>Wed</item>
7     <item>Thu</item>
8     <item>Fri</item>
9     <item>Sat</item>
10    <item>Sun</item>
11  </string-array>
12 </resources>
```

The editor includes a line number margin on the left and a tree view on the right. The tree view shows a root node 'resources' containing a child node 'string-array' with the attribute 'name="days\_of\_week"', which in turn contains seven 'item' nodes with values 'Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat', and 'Sun'.

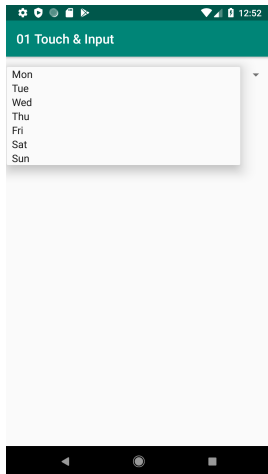
# ALTERNATIVE TO ARRAYOF

- `resources.getStringArray(id: Int)`

```
MainActivity.kt x
1 package com.example.cp01touchinput
2
3 import androidx.appcompat.app.AppCompatActivity
4 import android.os.Bundle
5 import android.widget.ArrayAdapter
6 import android.widget.Spinner
7 import kotlinx.android.synthetic.main.activity_main.*
8
9 class MainActivity : AppCompatActivity() {
10
11     override fun onCreate(savedInstanceState: Bundle?) {
12         super.onCreate(savedInstanceState)
13         setContentView(R.layout.activity_main)
14         val daysOfWeek = resources.getStringArray(R.array.days_of_week)
15         populateSpinner(spnDaysOfWeek, daysOfWeek)
16     }
17
18     private fun populateSpinner(spinner: Spinner, array: Array<String>) {
19         val layoutID: Int = android.R.layout.simple_spinner_item
20         spinner.adapter = ArrayAdapter<String>(context: this@MainActivity, layoutID, array)
21     }
22 }
```



# EMULATOR - ARRAYADAPTER



# ANDROID STUDIO: ANDROIDMANIFEST.XML

- ▶ Describes essential information about an application to the Android build tools, Android OS & Google Play
- ▶ Manifest file is required to declare:
  - ▶ Application's package name
  - ▶ Components of the application
  - ▶ Permissions
  - ▶ Hardware & software features

A screenshot of an IDE showing the AndroidManifest.xml file. The file is open in a tab titled 'AndroidManifest.xml'. The code is as follows:

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <manifest xmlns:android="http://schemas.android.com/apk/res/android"
3     package="com.example.cp01touchinput">
4
5     <application
6         android:allowBackup="true"
7         android:icon="@mipmap/ic_launcher"
8         android:label="@string/app_name"
9         android:roundIcon="@mipmap/ic_launcher_round"
10        android:supportRtl="true"
11        android:theme="@style/AppTheme">
12         <activity android:name=".MainActivity">
13             <intent-filter>
14                 <action android:name="android.intent.action.MAIN" />
15
16                 <category android:name="android.intent.category.LAUNCHER" />
17             </intent-filter>
18         </activity>
19     </application>
20
21 </manifest>
```

# ANDROID STUDIO: RESOURCES

- ▶ Android resource directories
  - ▶ Drawable
  - ▶ Layout
  - ▶ Mipmap
  - ▶ Values

# ANDROID STUDIO: RESOURCES - DRAWABLE

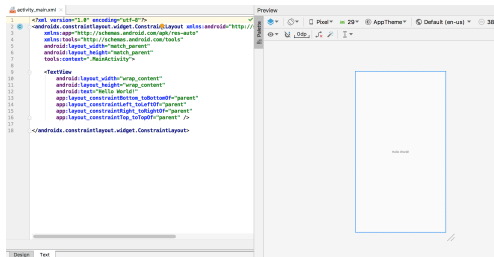
- ▶ General abstraction for something that can be drawn
- ▶ Type of resource retrieved for drawing things to the screen
- ▶ Generic API for dealing with an underlying visual resource
- ▶ Examples of drawables - bitmaps & vectors

# ANDROID STUDIO: RESOURCES - LAYOUT

- ▶ Defines the structure for a user interface in your application
- ▶ All elements in the layout are built using a hierarchy of **View** & **ViewGroup** objects
- ▶ **View** objects are called widgets
- ▶ **ViewGroup** objects are called layouts
- ▶ Two ways to declare a layout:
  - ▶ Declare user interface elements in XML - activity\_main.xml
  - ▶ Instantiate layout elements at runtime

# ANDROID STUDIO: RESOURCES - LAYOUT

- ▶ Each layout file must contain exactly one root element
  - ▶ Must be a **View** or **ViewGroup** object
- ▶ Add additional layout objects or widgets as child elements



# ANDROID STUDIO: RESOURCES - MIPMAP

- ▶ Drawable files for different launcher icon densities
- ▶ Image Asset Studio
- ▶ Generate application icons from material icons, custom images & text strings
- ▶ [Android Asset Studio - Roman Nurik](#)

# ANDROID STUDIO: RESOURCES - VALUES

- ▶ XML files that contain simple values such as colors, strings & styles
- ▶ Each child of the `<resources>` element defines a single resource
- ▶ For example, a `<string>` element creates an `R.string` resource

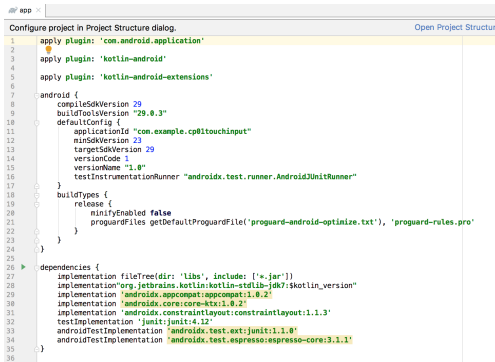


# ANDROID STUDIO: RESOURCE TYPES

- ▶ Menu & font - lecture 03
- ▶ XML - lecture 08
- ▶ Mipmap - lecture 14
- ▶ Anim - lecture 26

# ANDROID STUDIO: GRADLE

## ► build.gradle



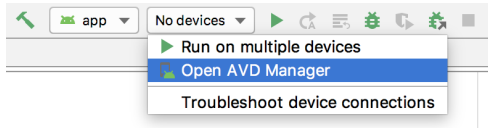
```
1  apply plugin: 'com.android.application'
2
3  apply plugin: 'kotlin-android'
4
5  apply plugin: 'kotlin-android-extensions'
6
7  android {
8      compileSdkVersion 29
9      buildToolsVersion "29.0.3"
10     defaultConfig {
11         applicationId "com.example.cp01touchinput"
12         minSdkVersion 23
13         targetSdkVersion 29
14         versionCode 1
15         versionName "1.0"
16         testInstrumentationRunner "androidx.test.runner.AndroidJUnitRunner"
17     }
18     buildTypes {
19         release {
20             minifyEnabled false
21             proguardFiles getDefaultProguardFile('proguard-android-optimize.txt'), 'proguard-rules.pro'
22         }
23     }
24 }
25
26 dependencies {
27     implementation fileTree(dir: 'libs', include: ['*.jar'])
28     implementation "org.jetbrains.kotlin:kotlin-stdlib-jdk7:$kotlin_version"
29     implementation 'androidx.appcompat:appcompat:1.0.2'
30     implementation 'androidx.core:core-ktx:1.0.2'
31     implementation 'androidx.constraintlayout:constraintlayout:1.1.3'
32     testImplementation 'junit:junit:4.12'
33     androidTestImplementation 'androidx.test.ext:junit:1.1.0'
34     androidTestImplementation 'androidx.test.espresso:espresso-core:3.1.1'
35 }
36
```

# ANDROID STUDIO: EMULATOR

- ▶ Simulates Android devices on your computer
- ▶ Test an application on a variety of devices & API levels
- ▶ Provides almost all of the capabilities of a real Android device

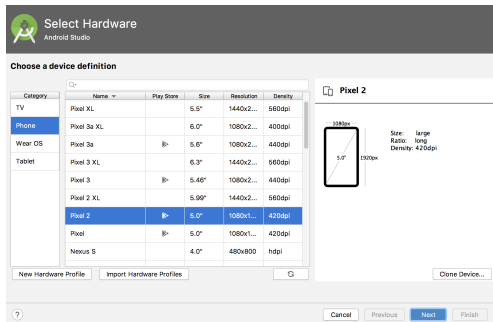
# ANDROID STUDIO: EMULATOR

## ► AVD Manager



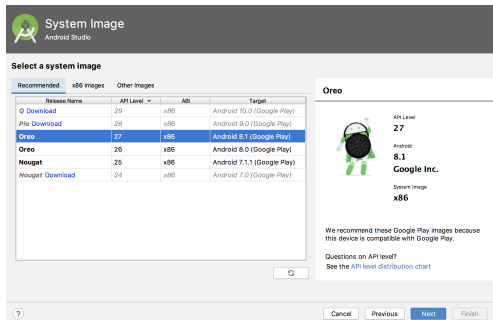
# ANDROID STUDIO: EMULATOR

- ▶ Selecting hardware
  - ▶ Category
  - ▶ Name



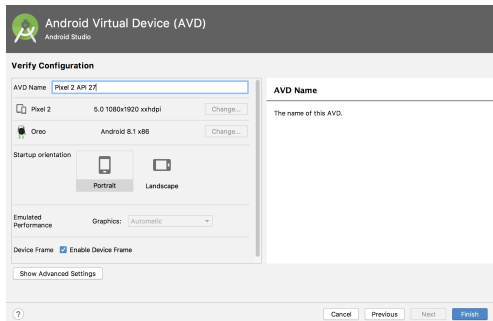
# ANDROID STUDIO: EMULATOR

- ▶ System Image
  - ▶ Release name
  - ▶ API level

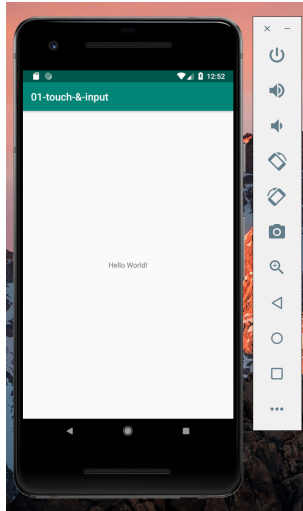


# ANDROID STUDIO: EMULATOR

- ▶ Verifying configuration
  - ▶ AVD name
  - ▶ Startup orientation



# ANDROID STUDIO: EMULATOR





# PRACTICAL

- ▶ Series of tasks covering today's lecture
- ▶ Worth 1% of your final mark for the Design and Development of Applications for Mobile Devices course
- ▶ Deadline: Friday, 12 June at 5pm

# ASSESSMENT 1 & 2

- ▶ Two assessments worth 20% & 25% - one individual & one group
- ▶ Worth 45% of your final mark for the Design and Development of Applications for Mobile Devices course
- ▶ Submission via **Assignments** tab on Microsoft Teams & GitHub
- ▶ Deadline: refer to course directive

# EXAMS

- ▶ Five individual exams worth 6% each
- ▶ Worth 30% of your final mark for the Design and Development of Applications for Mobile Devices course
- ▶ Submission via **Assignments** tab on Microsoft Teams
- ▶ Deadline: refer to course directive

# GITHUB REPOSITORIES

- ▶ A1: Language Translator - <http://bit.ly/mobile-language-translator>
- ▶ A2: Wishlist - <http://bit.ly/mobile-wishlist>
- ▶ Practicals - <http://bit.ly/mobile-practicals>
- ▶ Click [here](#) to view the **GitHub Classroom Setup** video

# LEARNER CAPABILITY FRAMEWORK

- ▶ LCF is based on national & international research
- ▶ **iamcapable** - web-based tool
  - ▶ Track the development of learner capabilities
  - ▶ Produce verified evidence of these capabilities
- ▶ Come see me for more information

# FORMATIVE ASSESSMENT

- ▶ Formative assessment questions:
  - ▶ What are the four Android resource directories?
  - ▶ What does the onCreate() method do in the Android activity lifecycle?
- ▶ Deadline: Friday, 21 February at 8am
- ▶ Click [here](#) to fill out the formative assessment