

CSC 472 / 372
Mobile Application
Development for Android



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Build Your
First Android App



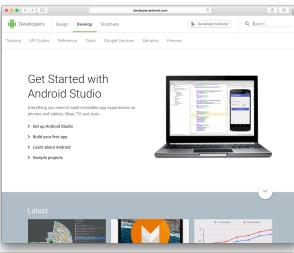
Outline

- Android SDK
- Android Studio
- Android SDK tools
 - SDK manager
 - AVD manager
- Building your first Android app
- Anatomy of an Android project

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Android Developer Portal

<http://developer.android.com/>



- SDK, tools
- Tutorials, videos
- Sample code
- API references
- Design guidelines
- Distribution

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Android Development Environment

- Android SDK (stand alone, SDK tool only, no IDE)
 - Android platform, libraries
 - Tools, and
 - Emulators
- IDE + Android SDK bundle
 - Android Studio (**required for this course**)
 - Official Android IDE
 - Eclipse + ADT plugin
 - Android IDE from the beginning
 - Official support will end by 2015
 - Eclipse ADT projects can be migrated to Android Studio

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Android Studio

- New Android IDE powered by IntelliJ
 - Latest version: 1.3 (July 2015)
- New Gradle based build system
 - Different project structure from Eclipse ADT
 - Can import projects created by Eclipse ADT
- Advanced code completion and refactoring
- Graphical layout editor
 - Preview on multiple screen sizes
- Virtual devices for different hardware and software configurations

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System Requirements

- Hardware
 - Windows® 7/8 (32- or 64-bit)
 - Mac OS X 10.5.8 or later
 - Linux (Ubuntu, Lucid Lynx)
- Java Platform, SE
 - JDK 6 or 7
 - Java 8 features are not supported
 - JRE alone is not sufficient
 - Install Java SE first.
 - The `bin` folder of Java must be included in PATH
 - Set environment variable `JAVA_HOME`

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Download Android Studio

<https://developer.android.com/sdk/index.html>

- Run installer
 - If unable to locate Java, set `JAVA_HOME`
 - (Optional) Add to `PATH`
 - `install dir/sdk/tools`
 - `install dir/sdk/platform-tools`
- Enable you to run the SDK tools from the command-line

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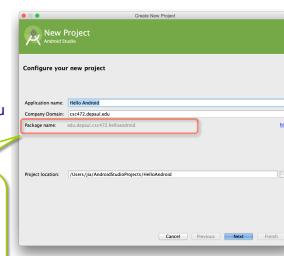
Create an New Android Project



New Project – Configuration

- Choose
 - Application name
 - e.g., `Hello Android`
 - Company domain
 - e.g., `csc472.depaul.edu`
- Click `Next`

`Package name` is derived from app name and company domain.
Must be unique across all installed apps.



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Launch Android Studio

- New project



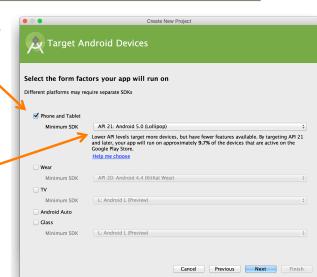
`Import project ...`
Import a project created by Eclipse + ADT

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New Project – Form Factor

- Choose a form factor
 - Phone and tablet
 - TV
 - Wear
 - Glass
- Choose a minimum SDK API level
- Click `Next`

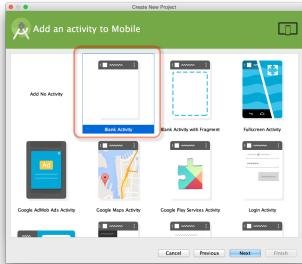


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New Project – Activity Template

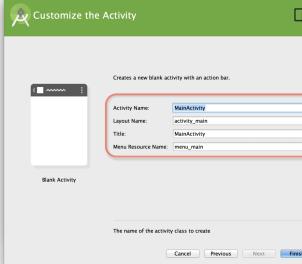
- Choose an Activity Template
- We will start with a *Blank Activity*
- Click *Next*



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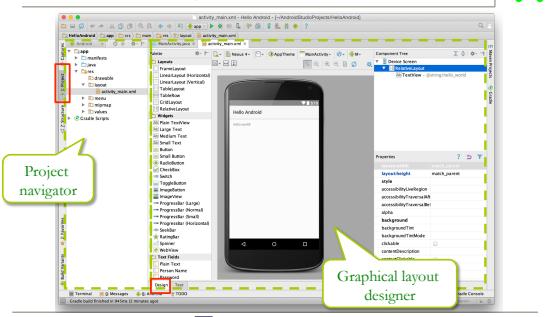
New Project – Blank Activity with an Action Bar

- Choose
 - Activity name
 - Layout name
 - Title
 - Menu resource name
- Use the default for this app
- Click *Finish*



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Android Project – Hello World!



Project navigator
Graphical layout designer
Layout preview

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Android Project – Hello World!



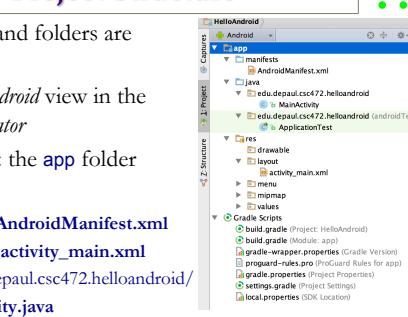
Project navigator
Text layout editor (XML)
Layout preview

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An Anatomy of an Android Project

Android Project Structure

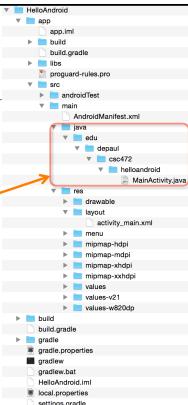
- Many files and folders are generated
- Use the *Android* view in the *Project navigator*
- Main focus: the *app* folder
- Key files:
 - manifests/AndroidManifest.xml*
 - res/layout/activity_main.xml*
 - java/edu.depaul.csc472.helloandroid/MainActivity.java*



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Android Project File Structure

- The file structure of an Android project
 - Not identical to the view in Android Studio,
 - e.g., the Java packages
 - Android Studio presents a simplified logical view of the contents
- The project file structure is **different** from Android project created by Eclipse + ADT
 - e.g., location of the `res` folder



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Android App

- A program focusing on performing a small set of related, highly cohesive tasks.
 - Small, focused, cohesive
- The smallest unit that can be packaged, installed, and distributed on Android platform
 - Presented on the home screen
 - Launched by the user
- Runs in its own sandbox
 - May interact with other apps
 - May access system services

More on app sandbox
in next lecture

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The Elements of a Simple Android App

A simple Android app consists of

- An *app manifest* (XML file)
 - `app/manifests/AndroidManifest.xml`
- App resources* (XML files)
 - Under `app/res`
 - layout, values, menu, drawable, etc.
- One or more *activities*. Each activity consists of
 - A Java class (Java file, under `app/java`), and
 - (Usually) an associated layout resource file (XML file)

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The Android App Manifest

- Required for every app
 - Located in the folder: `app/manifests/`
 - Must be named `AndroidManifest.xml`
- Include the essential information about the app
 - The components of the app
 - The main activity of the app, i.e., the launch point
 - System requirements to run the app
 - Permissions required to run the app
 - Internet, location, call, etc.

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The Android Activities

- Activities* are the one of the building blocks of apps
 - A unit of single, focused task that a user can do
- An activity
 - Serves as an entry point to app
 - An app may have multiple entry points
 - Has an associated UI, a single screen or a part of a screen
 - The UI can be created from resources or in code
 - Handles the responses to UI events
 - Interacts with other activities (inside or outside the app)
 - Responds to lifecycle events
 - (One of the) Smallest units that can be created or destroyed

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More on activities
in next lecture

The Android Resources

- Static data and contents used in the app
- Best practice:** externalize resources from code
 - Accommodate different configurations, e.g., screen sizes
 - Support localization, different languages, e.g., French, Chinese
- Defined in XML files
 - In subfolders under `res`
 - Organized by types and configurations (default, alternatives, etc.)
- Resource types:
 - Layout, string, menu, drawable, animation, style, etc.

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Android Resource – Layout

- Define the composition of UI in XML
 - The layout of a UI screen (of an activity), or
 - A component of the UI, which can be used elsewhere
- Stored in `res/layout/`
- A default layout file is created automatically
 - `res/layout/activity_main.xml`
 - It is associated with the main activity

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Hello Android – App Manifest

Manifest editor (Text/XML)

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Hello Android – App Manifest

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="edu.depaul.csc472.helloandroid" >
    <application
        android:allowBackup="true"
        android:icon="@drawable/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme" >
        <activity
            android:name=".MainActivity"
            android:label="@string/app_name" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

The main activity

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Hello Android – Layout The Graphical Layout Designer

UI component tree

UI property editor

Graphical layout editor

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Hello Android – Layout The Text Layout Editor

Layout preview

Layout editor (Text/XML)

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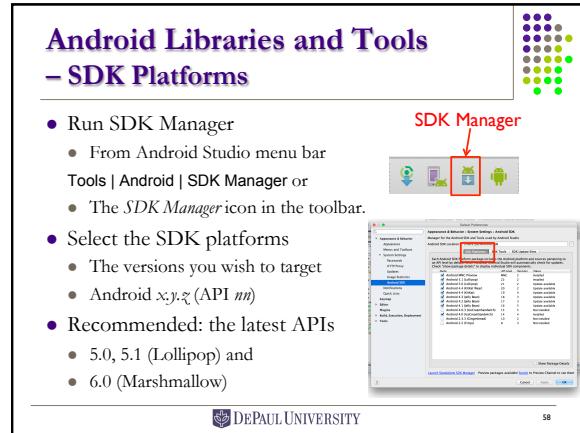
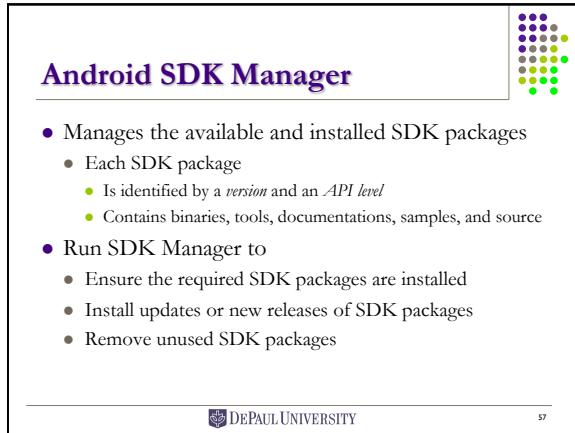
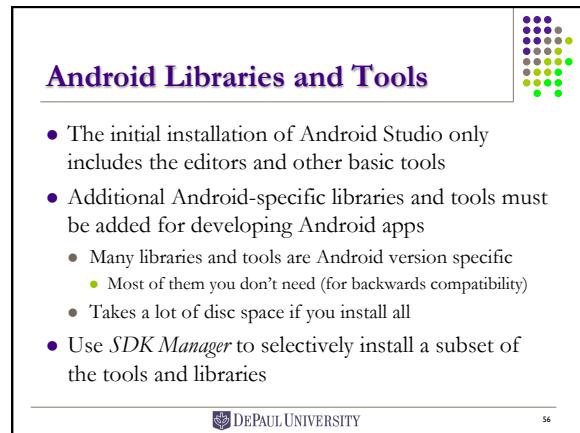
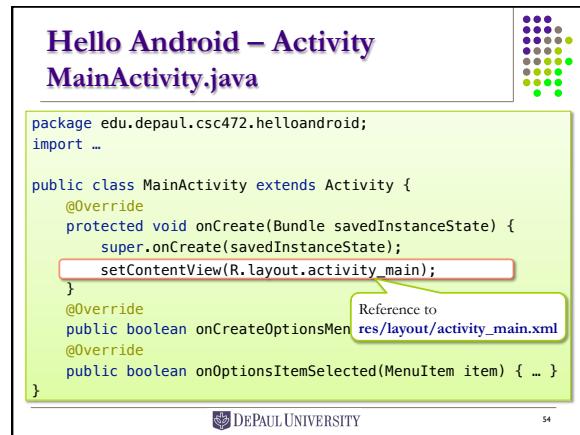
Hello Android – Layout `activity_main.xml`

```
<RelativeLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    android:paddingBottom="@dimen/activity_vertical_margin"
    tools:context=".MainActivity" >

    <TextView
        android:text="@string/hello_world"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content" />
</RelativeLayout>
```

Reference to string resource in `res/values/strings.xml`

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Android Libraries and Tools – SDK Platforms Details

- Install SDK platforms and system images
 - Check Show Package Details
 - SDK platform (required)
 - System images for the emulator (options available)
 - TV, Wear, ...
 - ARM, MIPS, Intel x86
 - x86_64 (64 bit)
 - Install at least one system image
 - e.g., Intel x86 (32 bit)

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Android Libraries and Tools – SDK Tools

- Install SDK tools & platform-tools
 - Required**
 - Android SDK Build Tools
 - Android SDK Tools
 - Android SDK Platform Tools
 - The rest are optional
 - Select the latest version
 - Recommended**
 - Intel x86 Emulator Accelerator (HAXM installer)

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Android Libraries and Tools – Support Libraries

- Android Support Libraries. **Optional**
- Extended APIs
 - Provide additional functions and compatibility support
 - Will be needed later
- Compatible with most versions of Android

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Android Virtual Device (AVD)

- An emulator configuration to simulate an actual device
 - configurable hardware and software options
- An AVD consists of
 - A hardware profile, e.g., keyboard, memory, etc.
 - A system image: target CPU chipset, API level
 - Other options: appearances, SD cards, etc.
- You need at least one AVD that**
 - AVD API level ≥ Minimum API level of your app

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Launch AVD Manager

- In Android Studio:
 - Tools | Android | AVD Manager, or
 - the *AVD Manager* icon in the toolbar.
- Command line:

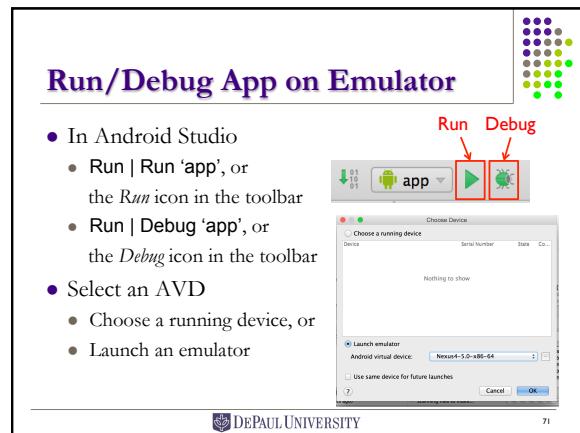
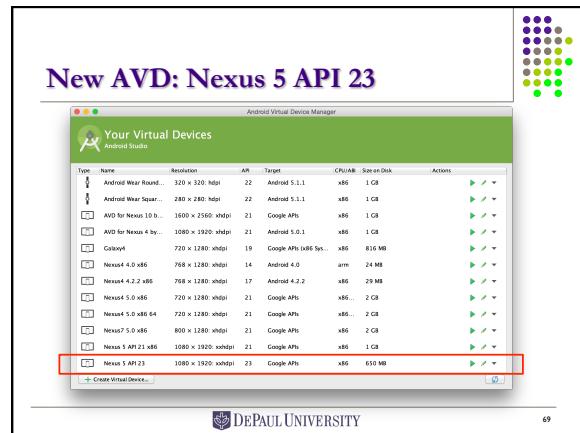
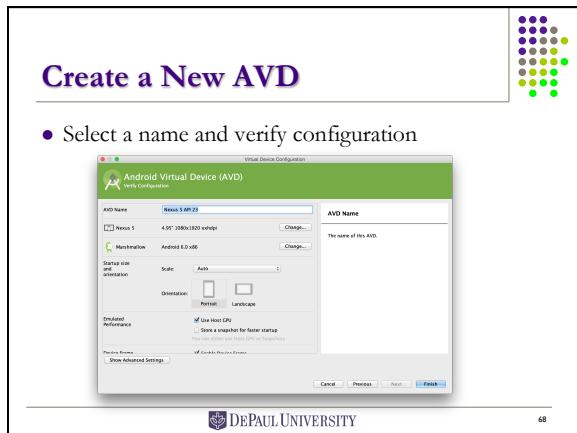
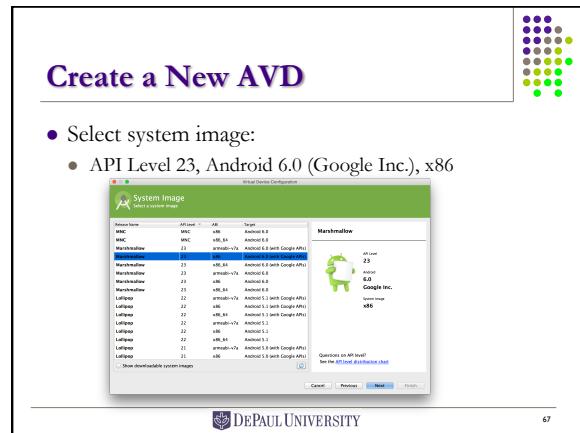
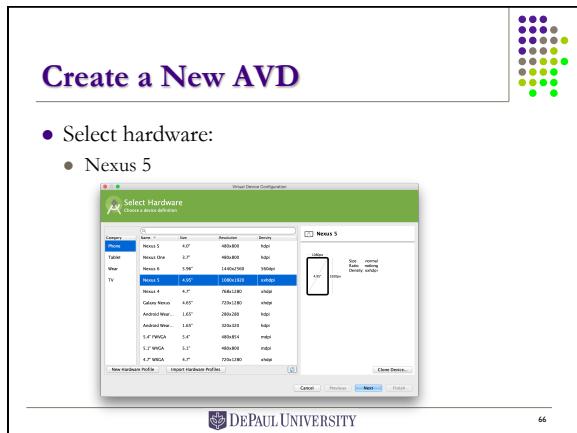

```
android avd
```

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Create a New AVD

Create new AVD

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Run App on Emulator

- Wait for the emulator to start
 - When launching a new emulator, booting may take a few minutes,
- Use host GPU will speed up the emulator



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Run App on Emulator Message Windows

- Messages in 'Run' or 'Debug' console (from system)

```

Run: [1] Installing edu.depaul.cs472.helloandroid
[2] Copying file from local disk to device...
Success
Launching application: edu.depaul.cs472.helloandroid/deepa...Activity
DEVICE SHELL COMMAND: am start -n "edu.depaul.cs472.helloandroid/deepa...Activity" --ei android.intent.action.MAIN --e...Activity
Starting: Intent { act=android.intent.action.MAIN cat=[...].Activity }

```

- Logcat messages in 'Android' window (from your app)

```

Emulator AVD for Nexus_4 by Google Android 5.0 (API 21) [ ] edu.depaul.cs472.helloandroid (1062)
[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [96] [97] [98] [99] [100] [101] [102] [103] [104] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147] [148] [149] [150] [151] [152] [153] [154] [155] [156] [157] [158] [159] [160] [161] [162] [163] [164] [165] [166] [167] [168] [169] [170] [171] [172] [173] [174] [175] [176] [177] [178] [179] [180] [181] [182] [183] [184] [185] [186] [187] [188] [189] [190] [191] [192] [193] [194] [195] [196] [197] [198] [199] [200] [201] [202] [203] [204] [205] [206] [207] [208] [209] [210] [211] [212] [213] [214] [215] [216] [217] [218] [219] [220] [221] [222] [223] [224] [225] [226] [227] [228] [229] [230] [231] [232] [233] [234] [235] [236] [237] [238] [239] [240] [241] [242] [243] [244] [245] [246] [247] [248] [249] [250] [251] [252] [253] [254] [255] [256] [257] [258] [259] [260] [261] [262] [263] [264] [265] [266] [267] [268] [269] [270] [271] [272] [273] [274] [275] [276] [277] [278] [279] [280] [281] [282] [283] [284] [285] [286] [287] [288] [289] [290] [291] [292] [293] [294] [295] [296] [297] [298] [299] [300] [301] [302] [303] [304] [305] [306] [307] [308] [309] [310] [311] [312] [313] [314] [315] [316] [317] [318] [319] [320] [321] [322] [323] [324] [325] [326] [327] [328] [329] [330] [331] [332] [333] [334] [335] [336] [337] [338] [339] [340] [341] [342] [343] [344] [345] [346] [347] [348] [349] [350] [351] [352] [353] [354] [355] [356] [357] [358] [359] [360] [361] [362] [363] [364] [365] [366] [367] [368] [369] [370] [371] [372] [373] [374] [375] [376] [377] [378] [379] [380] [381] [382] [383] [384] [385] [386] [387] [388] [389] [390] [391] [392] [393] [394] [395] [396] [397] [398] [399] [400] [401] [402] [403] [404] [405] [406] [407] [408] [409] [410] [411] [412] [413] [414] [415] [416] [417] [418] [419] [420] [421] [422] [423] [424] [425] [426] [427] [428] [429] [430] [431] [432] [433] [434] [435] [436] [437] [438] [439] [440] [441] [442] [443] [444] [445] [446] [447] [448] [449] [450] [451] [452] [453] [454] [455] [456] [457] [458] [459] [460] [461] [462] [463] [464] [465] [466] [467] [468] [469] [470] [471] [472] [473] [474] [475] [476] [477] [478] [479] [480] [481] [482] [483] [484] [485] [486] [487] [488] [489] [490] [491] [492] [493] [494] [495] [496] [497] [498] [499] [500] [501] [502] [503] [504] [505] [506] [507] [508] [509] [510] [511] [512] [513] [514] [515] [516] [517] [518] [519] [520] [521] [522] [523] [524] [525] [526] [527] [528] [529] [530] [531] [532] [533] [534] [535] [536] [537] [538] [539] [540] [541] [542] [543] [544] [545] [546] [547] [548] [549] [550] [551] [552] [553] [554] [555] [556] [557] [558] [559] [560] [561] [562] [563] [564] [565] [566] [567] [568] [569] [570] [571] [572] [573] [574] [575] [576] [577] [578] [579] [580] [581] [582] [583] [584] [585] [586] [587] [588] [589] [589] [590] [591] [592] [593] [594] [595] [596] [597] [598] [599] [600] [601] [602] [603] [604] [605] [606] [607] [608] [609] [610] [611] [612] [613] [614] [615] [616] [617] [618] [619] [620] [621] [622] [623] [624] [625] [626] [627] [628] [629] [630] [631] [632] [633] [634] [635] [636] [637] [638] [639] [640] [641] [642] [643] [644] [645] [646] [647] [648] [649] [650] [651] [652] [653] [654] [655] [656] [657] [658] [659] [660] [661] [662] [663] [664] [665] [666] [667] [668] [669] [669] [670] [671] [672] [673] [674] [675] [676] [677] [678] [679] [679] [680] [681] [682] [683] [684] [685] [686] [687] [688] [689] [689] [690] [691] [692] [693] [694] [695] [696] [697] [698] [699] [699] [700] [701] [702] [703] [704] [705] [706] [707] [708] [709] [709] [710] [711] [712] [713] [714] [715] [716] [717] [717] [718] [719] [719] [720] [721] [722] [723] [724] [725] [726] [727] [727] [728] [729] [729] [730] [731] [732] [733] [734] [735] [735] [736] [737] [737] [738] [739] [739] [740] [741] [741] [742] [743] [743] [744] [745] [745] [746] [747] [747] [748] [749] [749] [750] [751] [751] [752] [753] [753] [754] [755] [755] [756] [757] [757] [758] [759] [759] [760] [761] [761] [762] [763] [763] [764] [765] [765] [766] [767] [767] [768] [769] [769] [770] [771] [771] [772] [773] [773] [774] [775] [775] [776] [777] [777] [778] [779] [779] [780] [781] [781] [782] [783] [783] [784] [785] [785] [786] [787] [787] [788] [789] [789] [790] [791] [791] [792] [793] [793] [794] [795] [795] [796] [797] [797] [798] [799] [799] [800] [801] [801] [802] [803] [803] [804] [805] [805] [806] [807] [807] [808] [809] [809] [810] [811] [811] [812] [813] [813] [814] [815] [815] [816] [817] [817] [818] [819] [819] [820] [821] [821] [822] [823] [823] [824] [825] [825] [826] [827] [827] [828] [829] [829] [830] [831] [831] [832] [833] [833] [834] [835] [835] [836] [837] [837] [838] [839] [839] [840] [841] [841] [842] [843] [843] [844] [845] [845] [846] [847] [847] [848] [849] [849] [850] [851] [851] [852] [853] [853] [854] [855] [855] [856] [857] [857] [858] [859] [859] [860] [861] [861] [862] [863] [863] [864] [865] [865] [866] [867] [867] [868] [869] [869] [870] [871] [871] [872] [873] [873] [874] [875] [875] [876] [877] [877] [878] [879] [879] [880] [881] [881] [882] [883] [883] [884] [885] [885] [886] [887] [887] [888] [889] [889] [890] [891] [891] [892] [893] [893] [894] [895] [895] [896] [897] [897] [898] [899] [899] [900] [901] [901] [902] [903] [903] [904] [905] [905] [906] [907] [907] [908] [909] [909] [910] [911] [911] [912] [913] [913] [914] [915] [915] [916] [917] [917] [918] [919] [919] [920] [921] [921] [922] [923] [923] [924] [925] [925] [926] [927] [927] [928] [929] [929] [930] [931] [931] [932] [933] [933] [934] [935] [935] [936] [937] [937] [938] [939] [939] [940] [941] [941] [942] [943] [943] [944] [945] [945] [946] [947] [947] [948] [949] [949] [950] [951] [951] [952] [953] [953] [954] [955] [955] [956] [957] [957] [958] [959] [959] [960] [961] [961] [962] [963] [963] [964] [965] [965] [966] [967] [967] [968] [969] [969] [970] [971] [971] [972] [973] [973] [974] [975] [975] [976] [977] [977] [978] [979] [979] [980] [981] [981] [982] [983] [983] [984] [985] [985] [986] [987] [987] [988] [989] [989] [990] [991] [991] [992] [993] [993] [994] [995] [995] [996] [997] [997] [998] [999] [999] [999]
```

Edit App Resources



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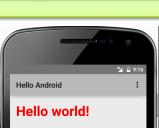
The TextView – Change Text Styles



```
<RelativeLayout ... >
    <TextView
        android:text="@string/hello_world"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:textColor="#ffff0000"
        android:textSize="36sp"
        android:textStyle="bold" />
</RelativeLayout>
```

Hexadecimal value of color: ARGB
Font size 36

What is sp?
Stay tuned



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Attributes of String Values



- The text attribute refers to a *string resource*

```
<TextView android:text="@string/hello_world" ... />
```

Strings begin with @ are references to resources (defined in XML)

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Attributes of String Values

- The text attribute refers to a *string resource*

```
<TextView android:text="@string/hello_world" ... />
```

- Two options to set the text attribute
 - Set the string value directly

```
<TextView android:text="Hello CSC472!" ... />
```

- Best practice:** Set the value as a string resource in `res/values/strings.xml`

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The String Resources

- Defines text strings used in app

- Stored in `res/values/strings.xml`

- A list of key-value pairs

```
<resources>
    <string name="key1">String value 1</string>
    <string name="key2">String value 2</string>
    ...
</resources>
```

- Reference to the string resources (in XML)

`@string/key1`

`@string/key2`

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Update the String Resources `res/values/strings.xml`

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="app_name">My First Android App</string>
    <string name="hello_world">Hello CSC472!\nWelcome to
    Android Development</string>
    <string name="action_settings">Settings</string>
</resources>
```



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Programming Assignments

- You must use Android Studio
- Set minimum API level to 21
- Submit a zip archive of the entire project folder
 - Close the project** before zipping the folder
 - The project folder should include sub-folders such as `app`, `build`, `gradle`, etc.

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References

- IntelliJ on-line documentation
<http://www.jetbrains.com/idea/webhelp/viewing-inline-documentation.html>
- Android Studio tips & tricks
<https://developer.android.com/sdk/installing/studio-tips.html>

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Next ...

- Android app fundamentals
- Android user interface (UI) framework
- Layouts
- Widgets
- Activities

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