CS 528 Mobile and Ubiquitous Computing
Lecture 2a: Android UI Design in XML + Examples

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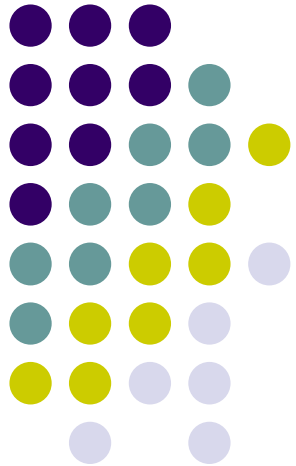
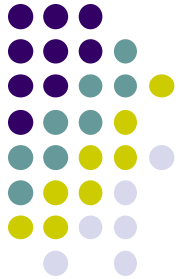




Android UI Design in XML

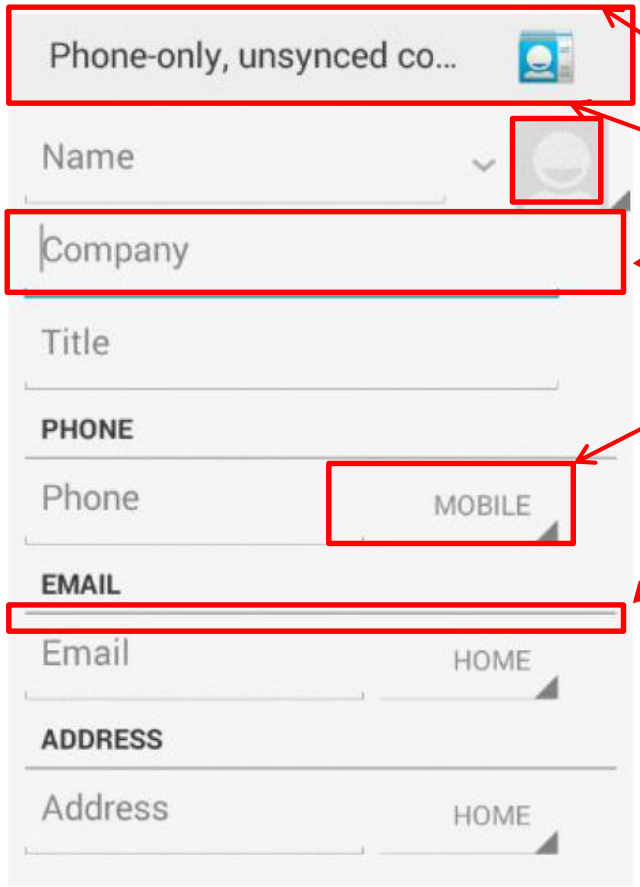
Recall: Files Hello World Android Project

XML file used to design Android UI

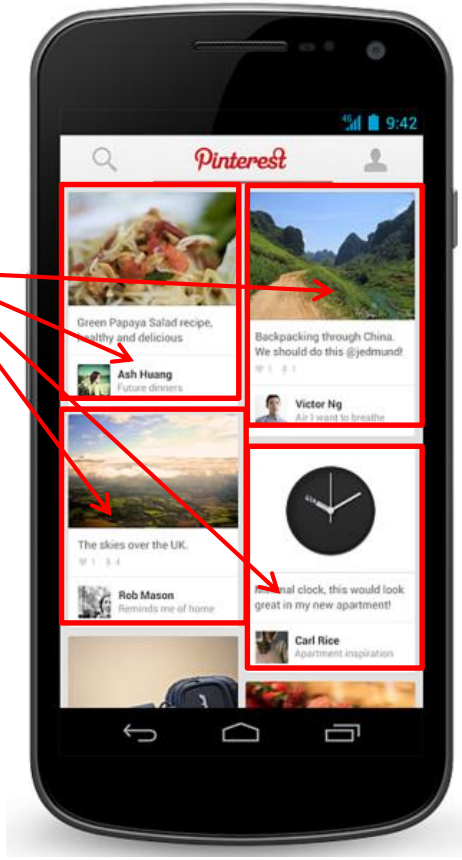
- 3 Files:
  - **Activity_main.xml:** XML file specifying screen layout
  - **MainActivity.Java:** Java code to define behavior, actions taken when button clicked (intelligence)
  - **AndroidManifest.xml:**
    - Lists all app components and screens
    - Like a table of contents for a book
    - E.g. Hello world program has 1 screen, so AndroidManifest.xml has 1 item listed
    - App starts running here (a bit like main( ) in C), launching activity with a tag “LAUNCHER”

Widgets

- ***Android UI design involves arranging widgets on a screen***
- **Widgets?** Rectangles containing texts, image, etc
- **Screen design:** Pick widgets, specify attributes (dimensions, margins, etc)

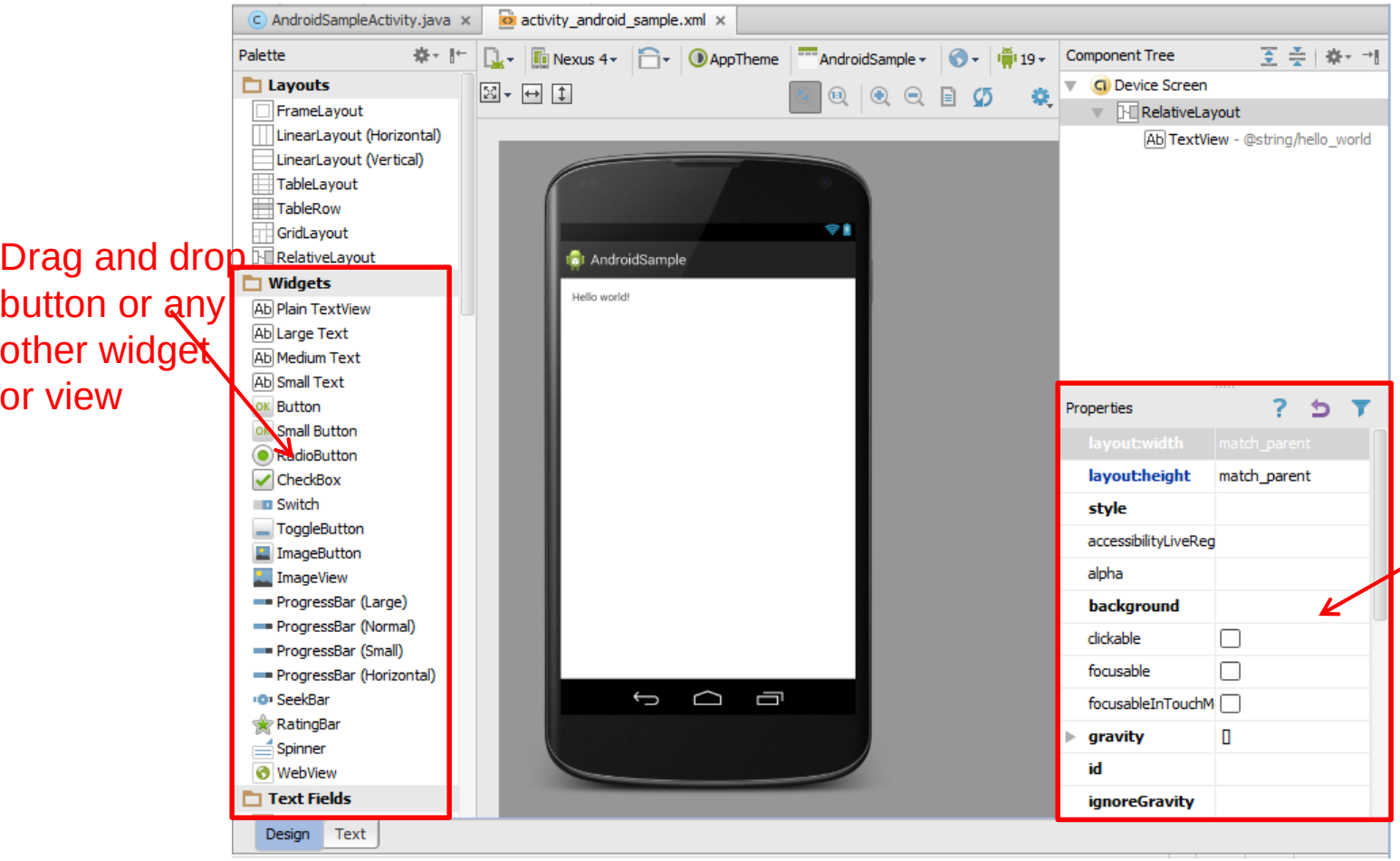


Widgets



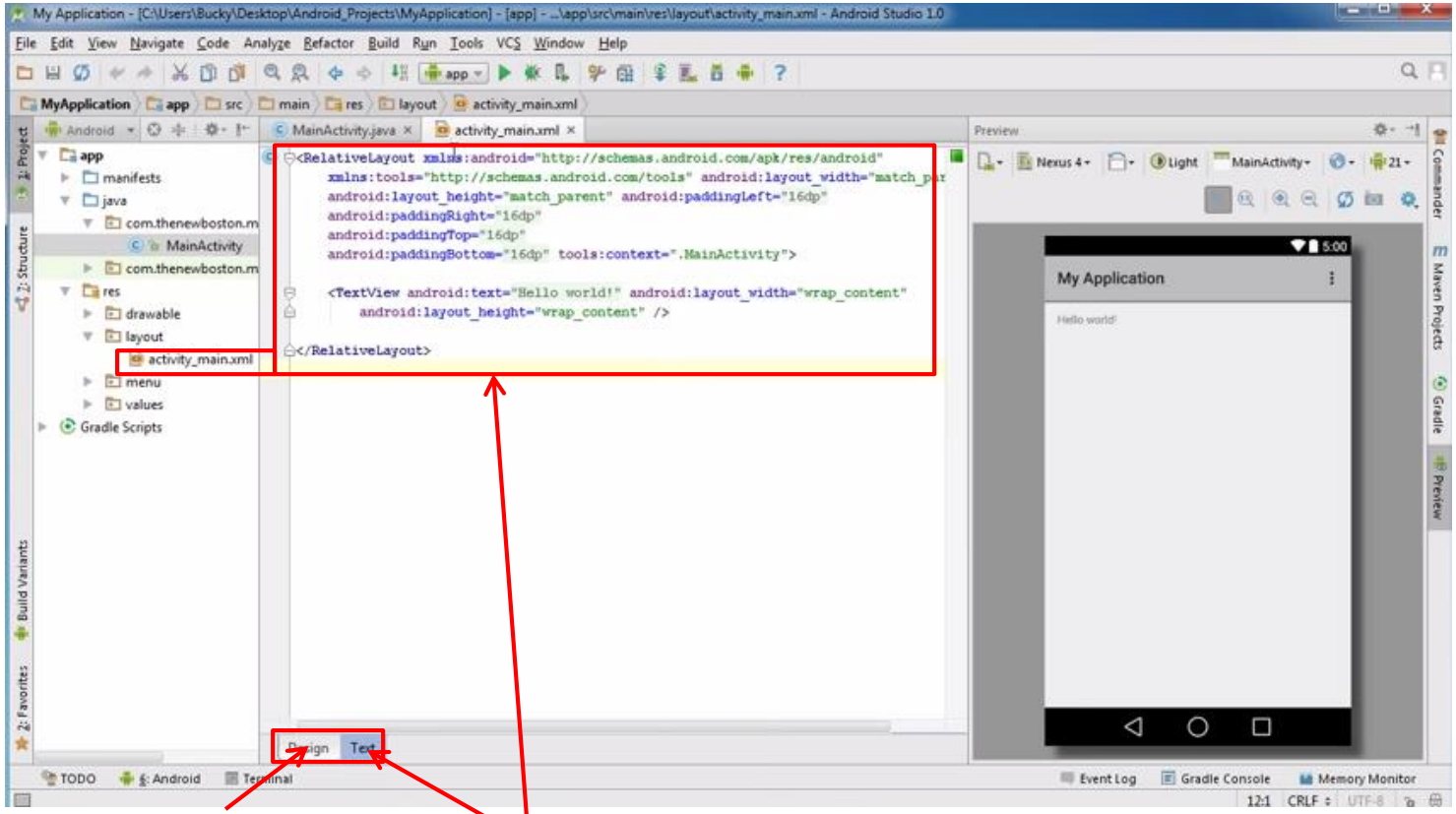
Recall: Design Option 1: Drag and Drop Widgets

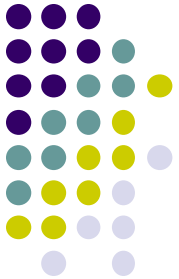
- Drag and drop widgets in Android Studio Design View
- Edit widget properties (e.g. height, width, color, etc)



Recall: Design Option 2: Edit XML Directly

- **Text view:** Directly edit XML file defining screen (activity_main.xml)
- **Note:** dragging and dropping widgets in design view auto-generates corresponding XML in Text view

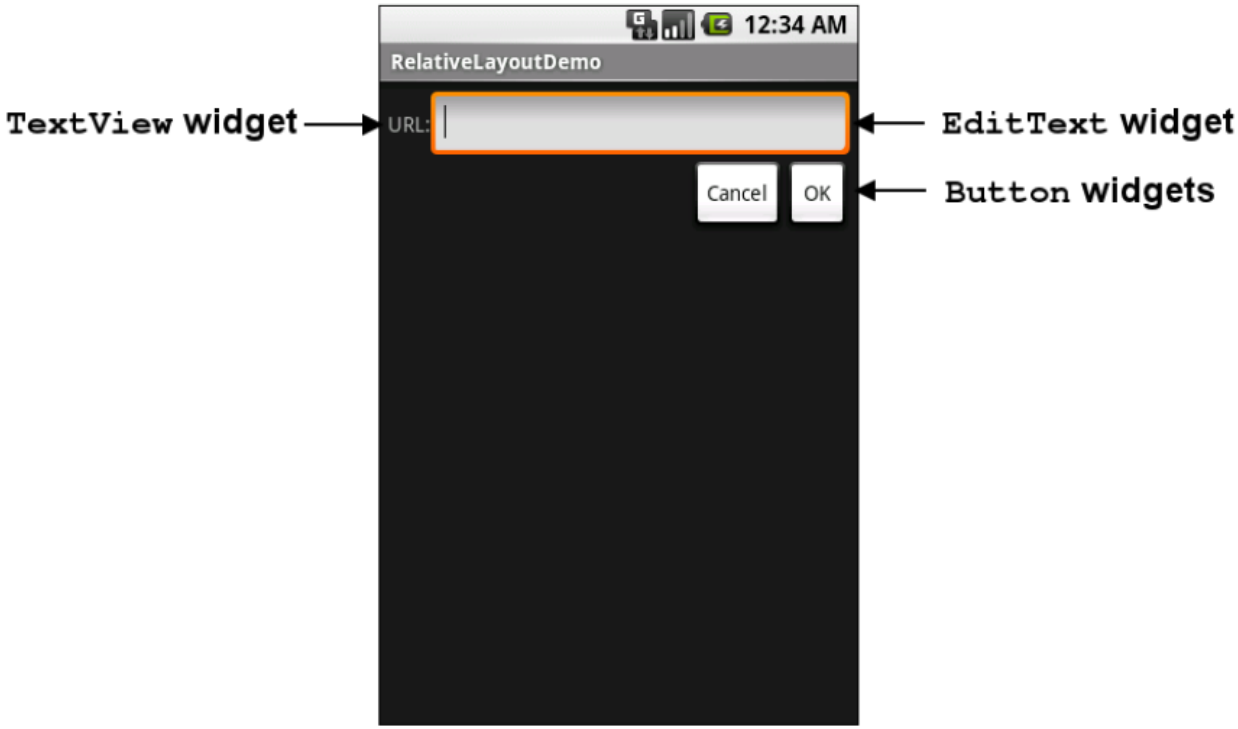




Android Widgets

Example: Some Common Widgets

- **TextView:** Text in a rectangle
- **EditText:** Text box for user to type in text
- **Button:** Button for user to click on



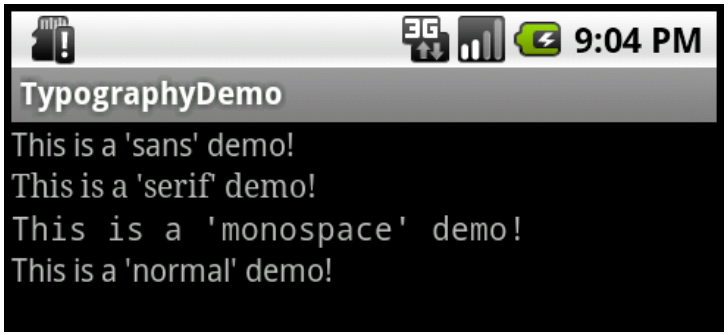
TextView Widget

- Text in a rectangle
- Just displays text, no interaction

XML code

```
<TextView
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:text="This is a 'sans' demo!"
    android:typeface="sans"
/>
```

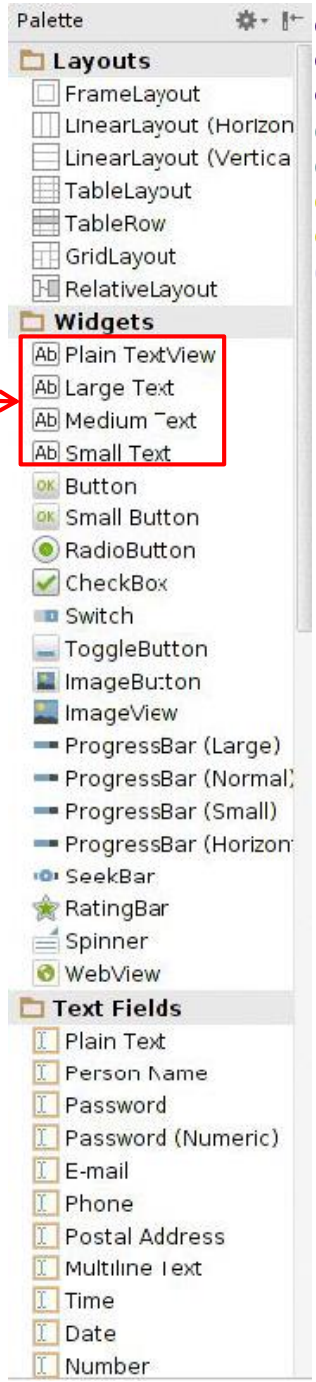
TextView Widgets



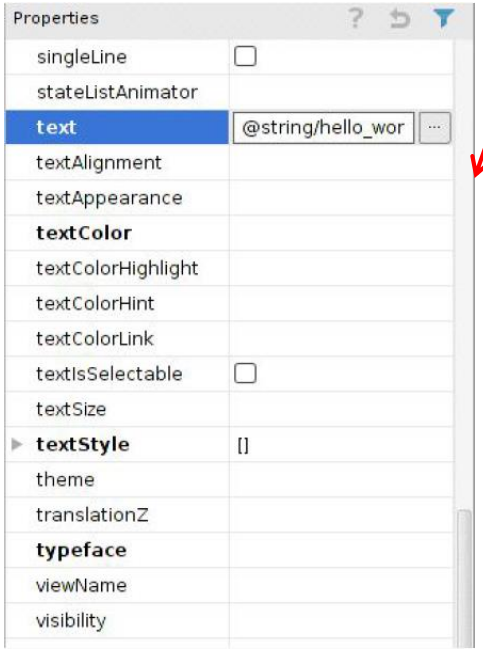
- **Common attributes:**
  - typeface (android:typeface e.g monospace), bold, italic, (android:textStyle), text size, text color (android:textColor e.g. #FF0000 for red), width, height, padding, background color
  - Can also include links to email address, url, phone number,
    - web, email, phone, map, etc

TextView

- TextView widget is available in widgets palette in Android Studio Layout editor
  - **Plain TextView**, **Large text, Medium text** and **Small text**

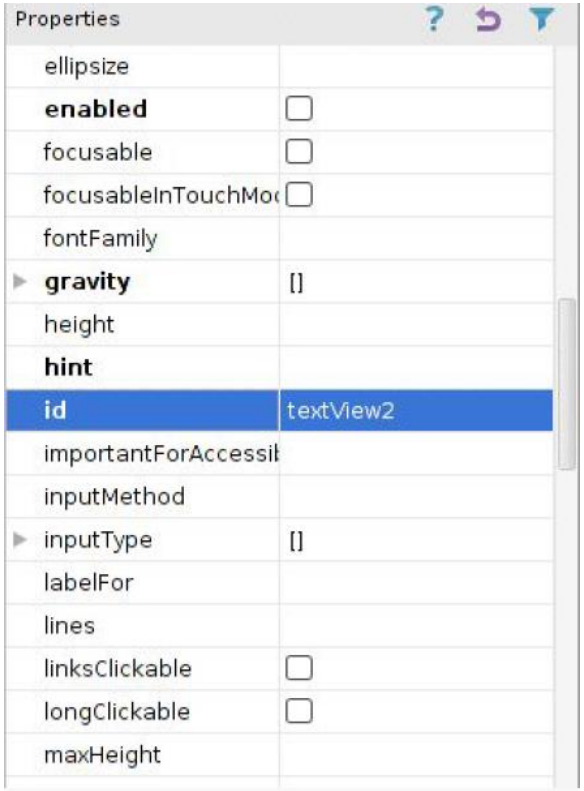


- After dragging Textview widget in, edit properties



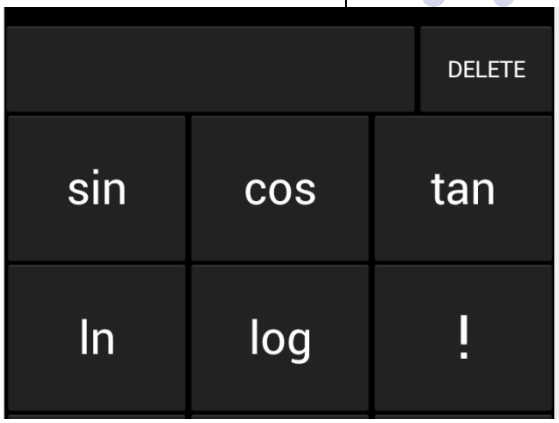
Widget ID

- Every widget has ID, stored in **android:id** attribute
- Using Widget ID declared in XML, widget can be referenced, modified in java code (More later)

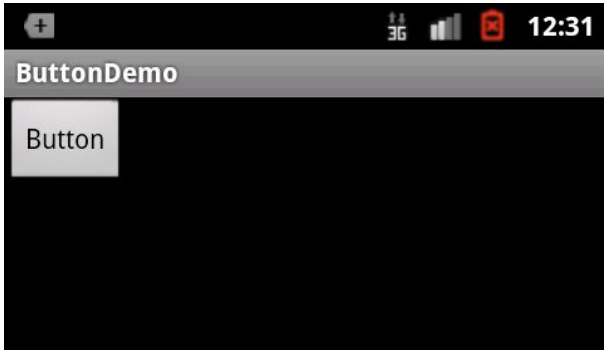


Button Widget

- Clickable Text or icon on a Widget (Button)
- E.g. “Click Here”
- Appearance can be customized
- Declared as subclass of TextView so similar attributes (e.g. width, height, etc)



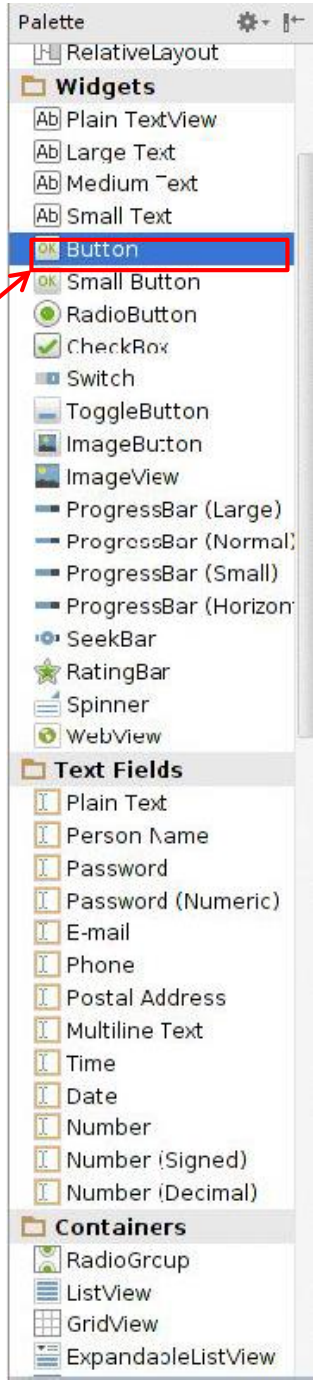

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
  android:layout_width="match_parent"
  android:layout_height="match_parent"
  android:orientation="vertical">

  <Button
    android:id="@+id/button1"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/button"/>

</LinearLayout>
```



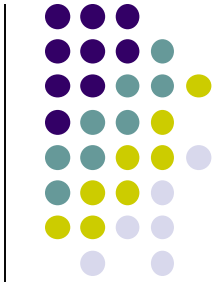
Button in Android Studio

- **Button** widget available in palette of Android Studio graphical layout editor

- Drag and drop button, edit its attributes



Responding to Button Clicks



- May want Button press to trigger some action
- How?

1. **In XML file (e.g. Activity_my.xml), set android:onClick attribute to specify method to be invoked**

2. **In Java file (e.g. MainActivity.java) declare method/handler to take desired action**

Activity_my.xml

```
<Button
  android:onClick="someMethod"
  ...
/>
```

MainActivity.java

```
public void someMethod(View theButton) {
  // do something useful here
}
```

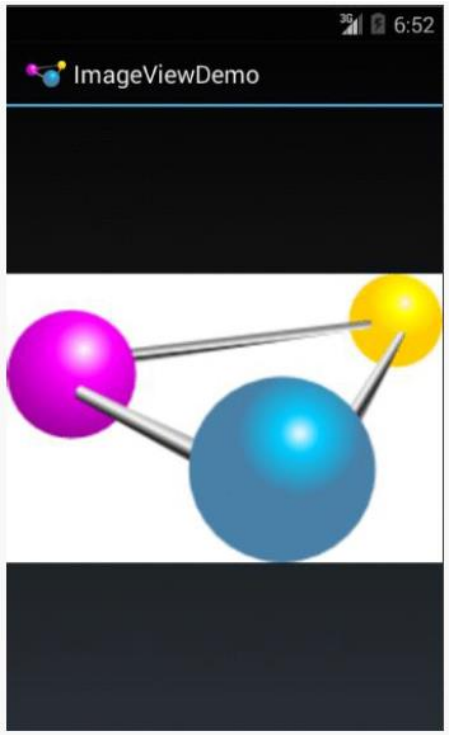
Embedding Images: ImageView and ImageButton

- **ImageView:** display image (not clickable)
- **ImageButton:** Clickable image

- Use **android:src** attribute to specify image source in **drawable** folder (e.g. **@drawable/icon**)

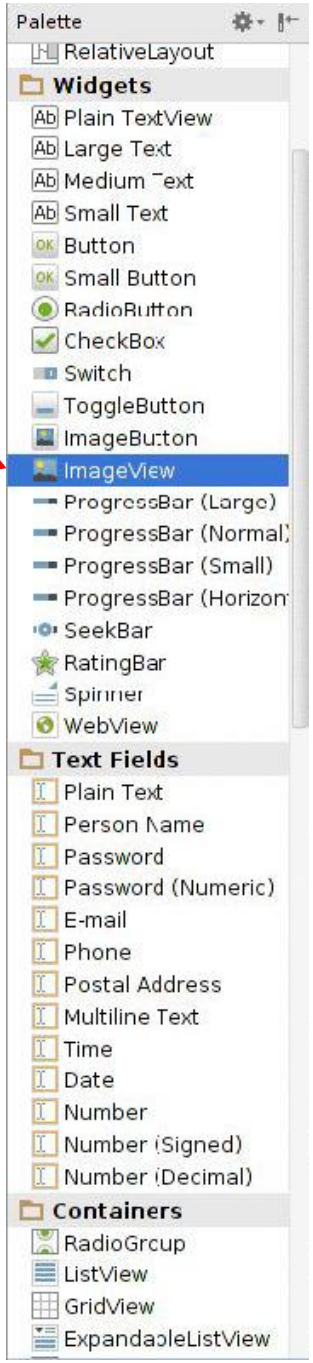
```
<?xml version="1.0" encoding="utf-8"?>
<ImageView xmlns:android="http://schemas.android.com/apk/res/android"
  android:id="@+id/icon"
  android:layout_width="match_parent"
  android:layout_height="match_parent"
  android:adjustViewBounds="true"
  android:src="@drawable/molecule"/>
```

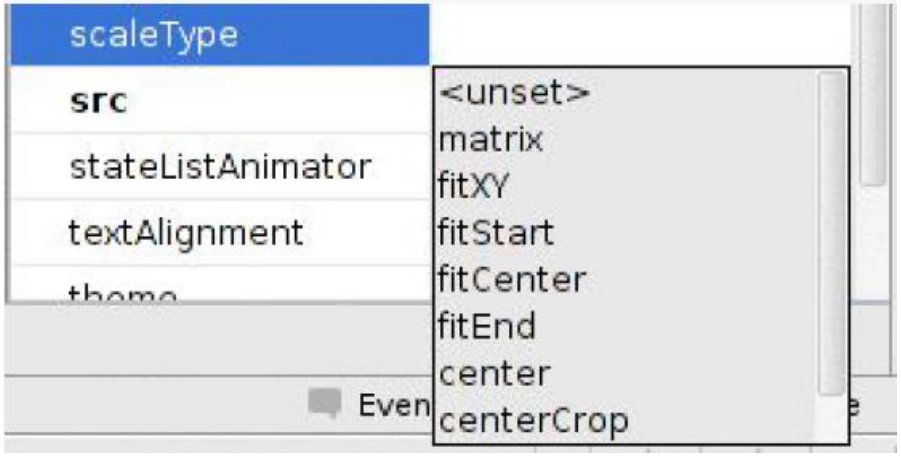
File molecule.png in drawable/ folder



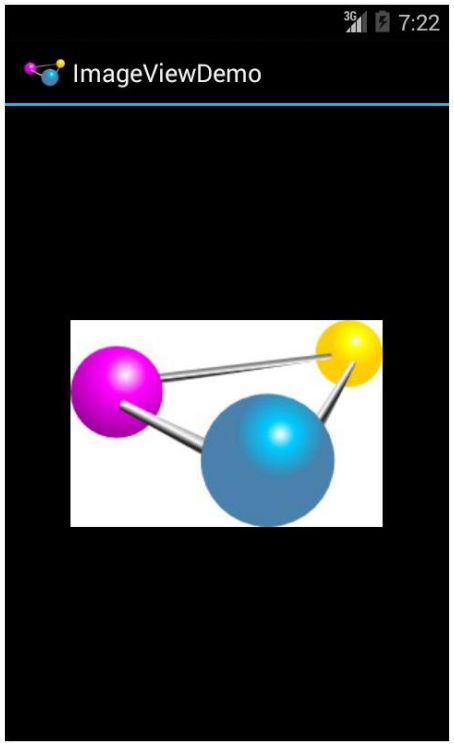
ImageView in Widgets Palette

- Can drag and drop ImageView from Widgets Palette
- Use pop-up menus (right-click) to specify:
  - **src:** choose image to be displayed
  - **scaleType:** choose how image should be scaled

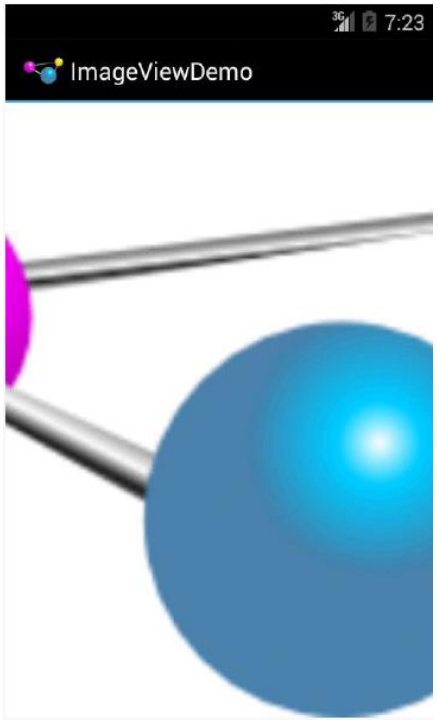




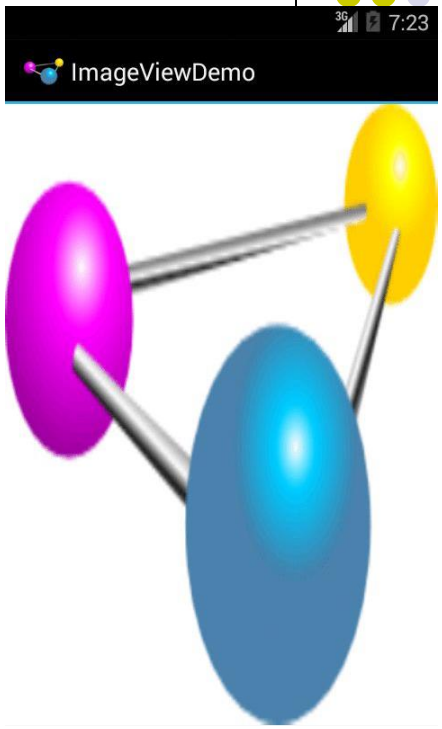
Options for Scaling Images (scaleType)



“center” centers image but does not scale it



“centerCrop” centers image, scales it (maintaining aspect ratio) so that shorter dimension fills available space, and crops longer dimension

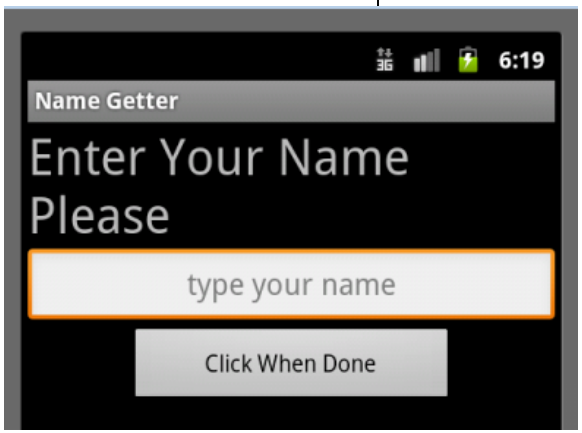


“fitXY” scales/distorts image to fit ImageView, ignoring aspect ratio

EditText Widget

- Widget with box for user input
- Example:

```
<EditText
      android:id="@+id/edittext"
      android:layout_width="fill_parent"
      android:layout_height="wrap_content"
      android:layout_gravity="center"
      android:gravity="center"
      android:inputType="textPersonName"
      android:hint="type your name" />
```

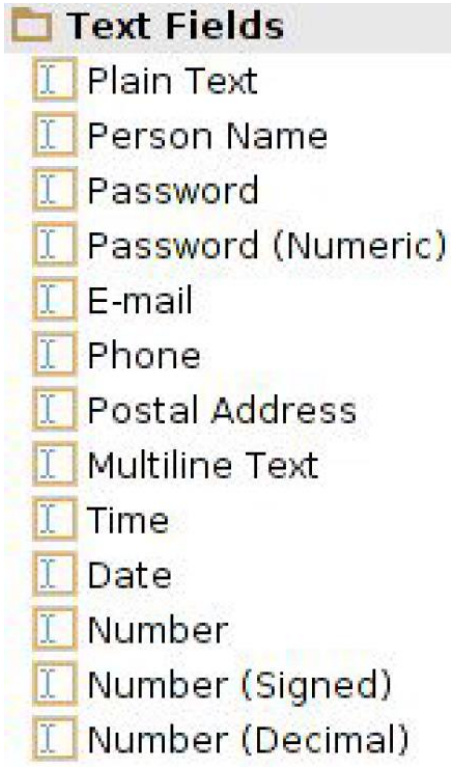


- Text fields can have different input types
  - e.g. number, date, password, or email address

- **android:inputType** attribute sets input type, affects
  - What type of keyboard pops up for user
  - E.g. if inputType is a number, numeric keyboard pops up

EditText Widget in Android Studio Palette

- A section of Android Studio palette has EditText widgets (or text fields)



Text Fields
Section of Widget palette

EditText inputType menu

Some Other Available Widgets

MapView

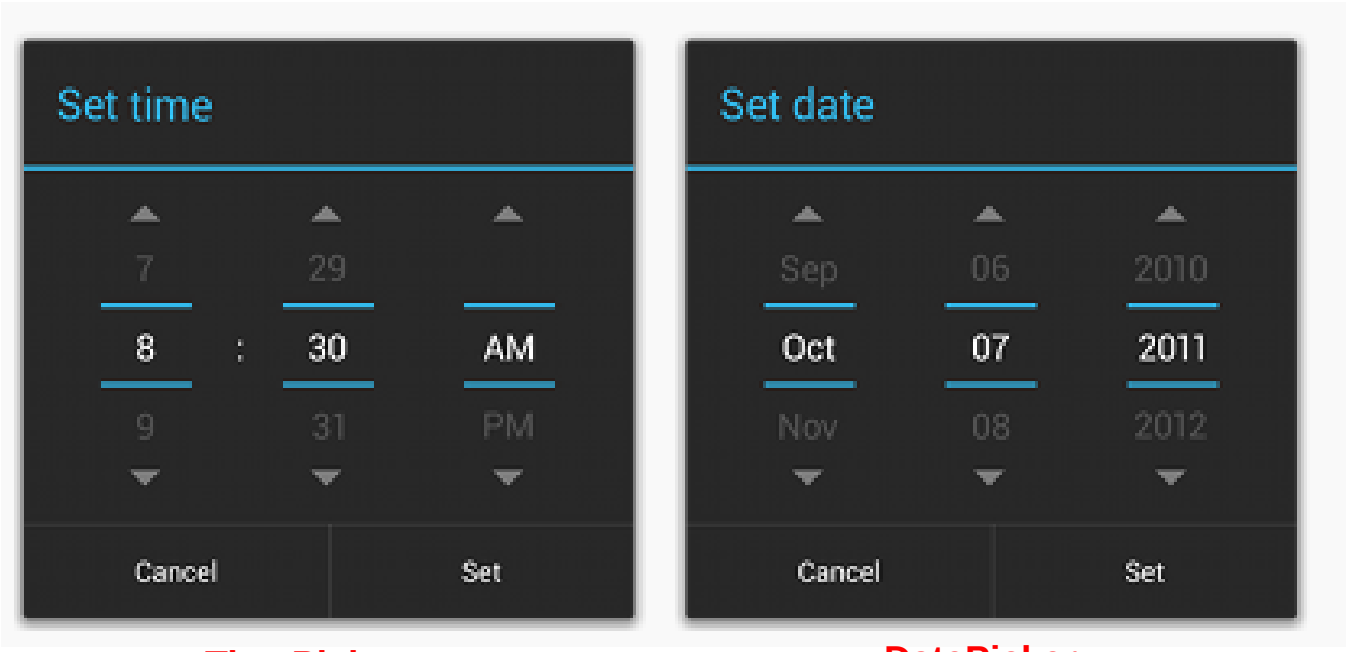
Rectangle that contains a map

WebView

Rectangle that contains a web page

Pickers

- **TimePicker:** Select a time
- **DatePicker:** Select a date
- Typically displayed in pop-up dialogs (**TimePickerDialog** or **DatePickerDialog**)

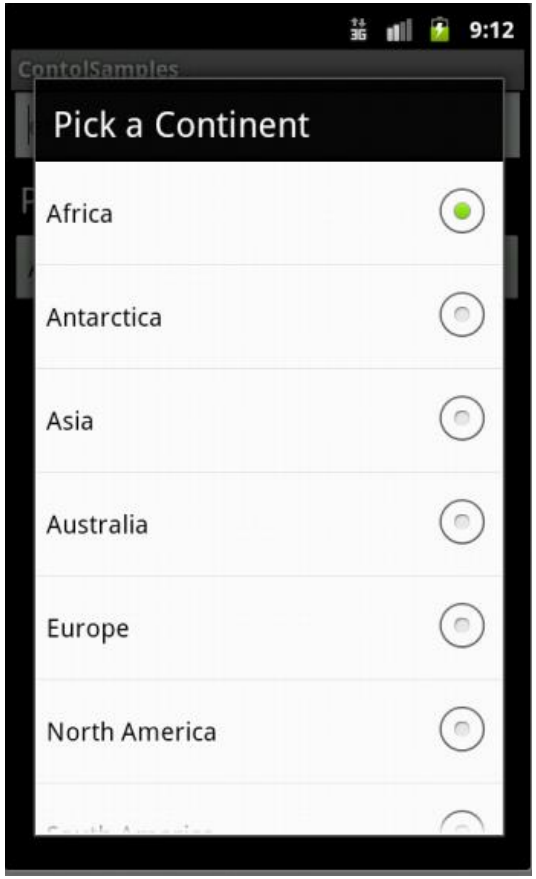


TimePicker

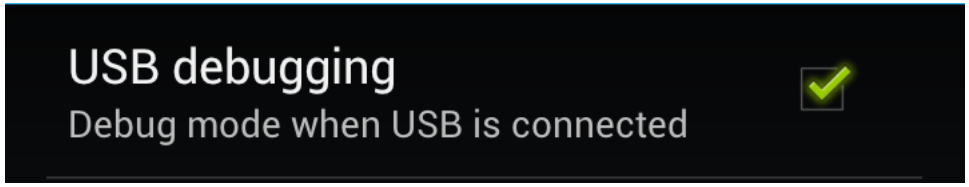
DatePicker

Spinner Controls

- user **must** select one of a set of choices



Checkbox



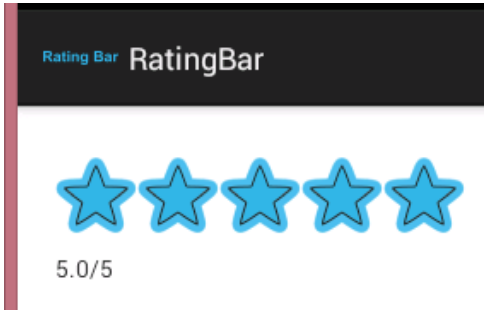
- Checkbox has 2 states: checked and unchecked
- XML code to create Checkbox

```
<?xml version="1.0" encoding="utf-8"?>
<CheckBox xmlns:android="http://schemas.android.com/apk/res/android"
  android:id="@+id/check"
  android:layout_width="wrap_content"
  android:layout_height="wrap_content"
  android:text="@string/unchecked"/>
```

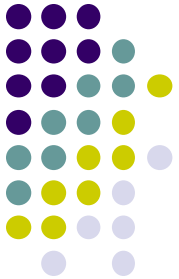
Other Indicators

- ProgressBar

- RatingBar

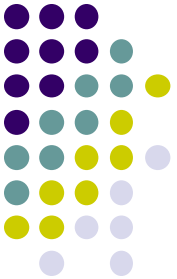


- Chronometer
- DigitalClock
- AnalogClock



Android Layouts in XML

Android UI using XML Layouts



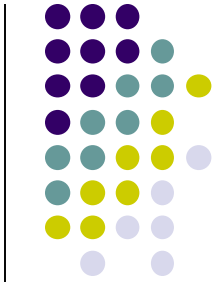
- Layout? Pattern in which multiple widgets are arranged
- Layouts contain widgets
- In Android internal classes, widget is child of layout
- Layouts (XML files) stored in **res/layout**

LinearLayout

RelativeLayout

TableLayout

Some Layouts



- FrameLayout,
- LinearLayout,
- TableLayout,
- GridLayout,
- RelativeLayout,
- ListView,
- GridView,
- ScrollView,
- DrawerLayout,
- ViewPager

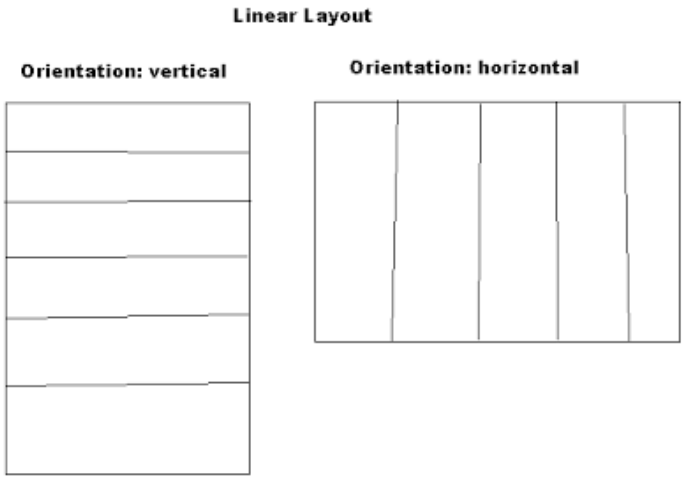
LinearLayout

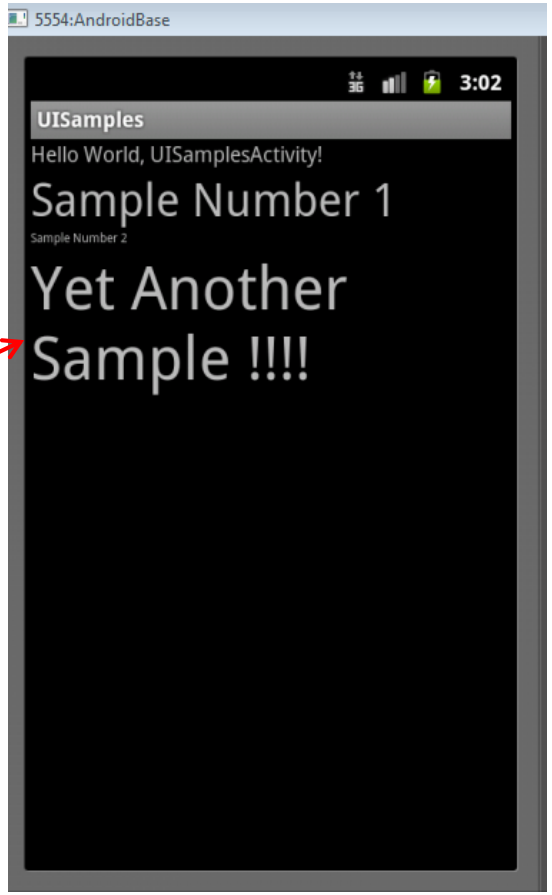
- aligns child elements (e.g. buttons, text boxes, pictures, etc.) in one direction
- Example:

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.c
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
        android:background="#ff00ff"
    android:orientation="vertical" >
```

Layout properties

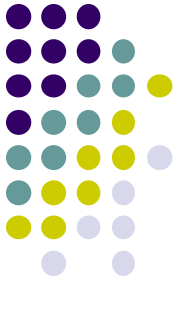
- orientation attribute defines direction (vertical or horizontal):
  - E.g. android:orientation="*vertical*"





Layout Width and Height Attributes

- **wrap_content:** widget as wide/high as its content (e.g. text)
- **match_parent:** widget as wide/high as its parent layout box
- **fill_parent:** older form of **match_parent**



Text widget width should be as wide as Its parent (the layout)

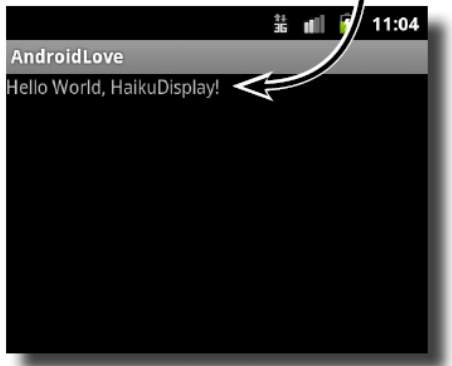
Text widget height should Be as wide as the content (text)

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent" >
    <TextView
        android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:text="@string/hello"
        />
</LinearLayout>
```

The View inside the layout is a TextView, a View specifically made to display text.

XML

main.xml



The ViewGroup, in this case a LinearLayout fills the screen.

Hierarchy

Screen (Hardware)

↑

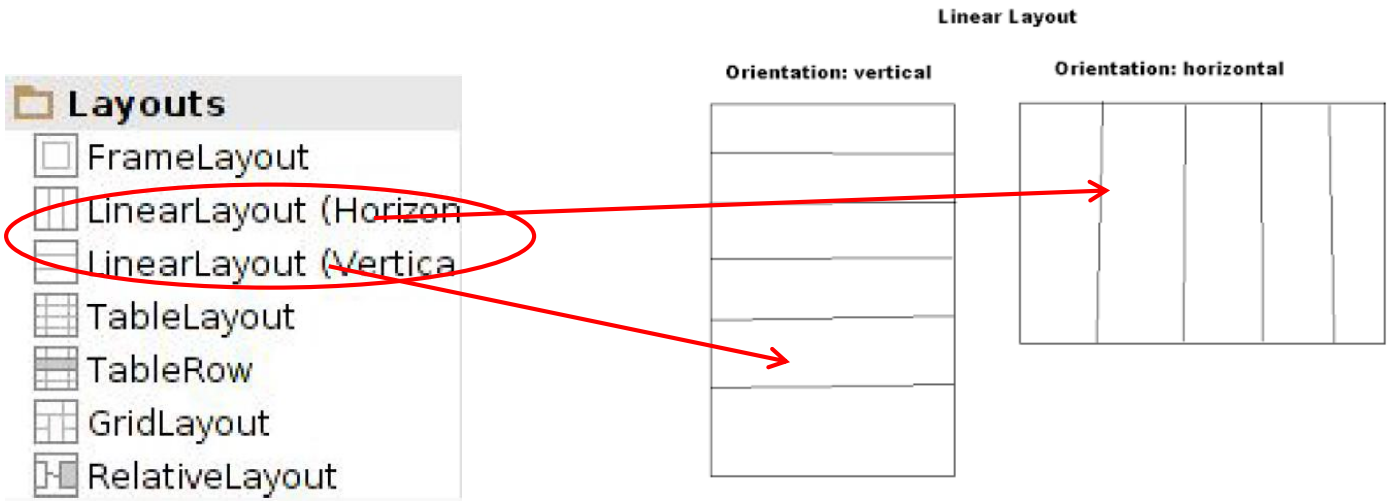
Linear Layout

↑

TextView

LinearLayout in Android Studio

- LinearLayout in Android Studio Graphical Layout Editor

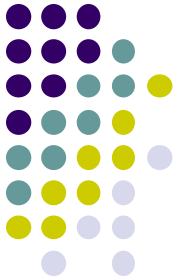


- After selecting LinearLayout, toolbars buttons to set parameters

Toggle width, height between match_parent and wrap_content

Change gravity of LinearLayout (more on this later)

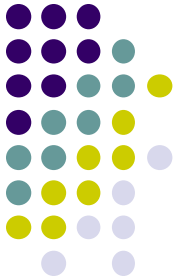
LinearLayout Attributes



XML attributes	
android:baselineAligned	When set to false, prevents the layout from aligning its children's baselines.
android:baselineAlignedChildIndex	When a linear layout is part of another layout that is baseline aligned, it can specify which of its children to baseline align to (that is, which child TextView).
android:divider	Drawable to use as a vertical divider between buttons.
android:gravity	Specifies how an object should position its content, on both the X and Y axes, within its own bounds.
android:measureWithLargestChild	When set to true, all children with a weight will be considered having the minimum size of the largest child.
android:orientation	Should the layout be a column or a row? Use "horizontal" for a row, "vertical" for a column.
android:weightSum	Defines the maximum weight sum.

Ref: https://developer.android.com/reference/android/widget/LinearLayout.html

Setting Attributes



```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.c
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
        android:background="#ff00ff"
    android:orientation="vertical" >
```

in layout xml file

```
public class UISamplesActivity extends Activity {
    /** Called when the activity is first created. */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
    }

    public void change(View v) {
        LinearLayout vg = (LinearLayout)this.findViewById(R.id.main_layout);
        Log.d("UI SAMPLE", vg + "");
        vg.setOrientation(LinearLayout.HORIZONTAL);
    }
}
```

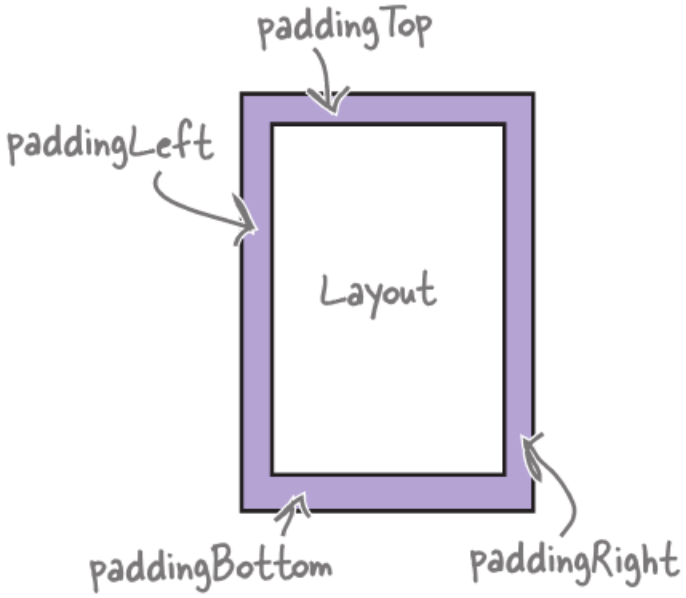
Can also design UI, set attributes in Java program (e.g. ActivityMain.java) (More later)

Adding Padding

- Paddings sets space between layout sides and its parent (e.g. the screen)

```
<RelativeLayout ...
    android:paddingBottom="16dp"
    android:paddingLeft="16dp"
    android:paddingRight="16dp"
    android:paddingTop="16dp">
    ...
</RelativeLayout>
```

Add padding of 16dp.

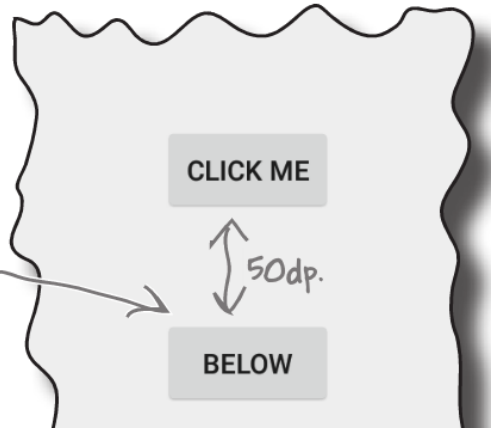


Setting Margins

- Can increase gap (margin) between adjacent widgets
- E.g. To add margin between two buttons, in declaration of bottom button

```
<Button
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_alignLeft="@+id/button_click_me"
    android:layout_below="@+id/button_click_me"
    android:layout_marginTop="50dp"
    android:text="@string/button_below" />
</RelativeLayout>
```

Adding a margin to the top of the bottom button adds extra space between the two views.



- Other options

android:layout_marginLeft

android:layout_marginRight

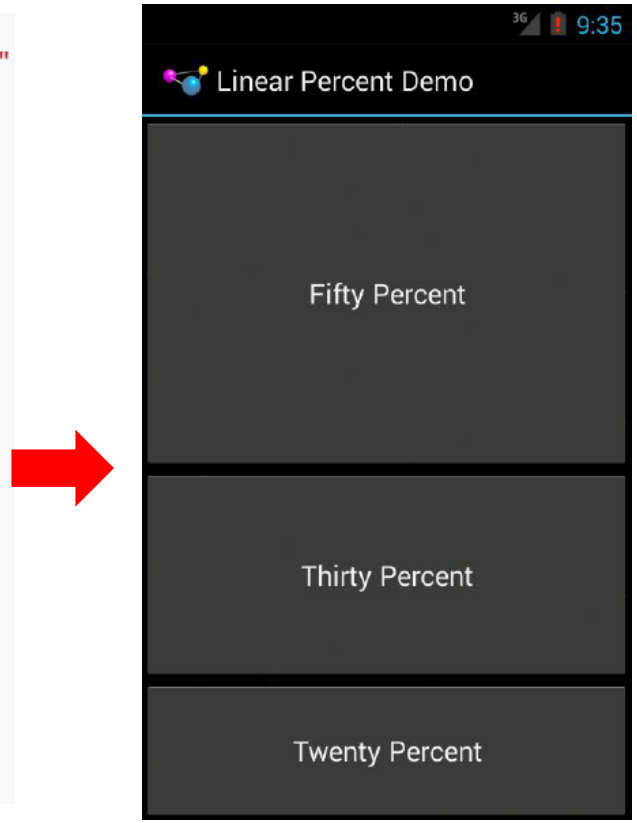
Gravity Attribute

- By default, linearlayout left- and top-aligned
- Gravity attribute changes alignment :
  - e.g. android:gravity = “right”

Linear Layout Weight Attribute

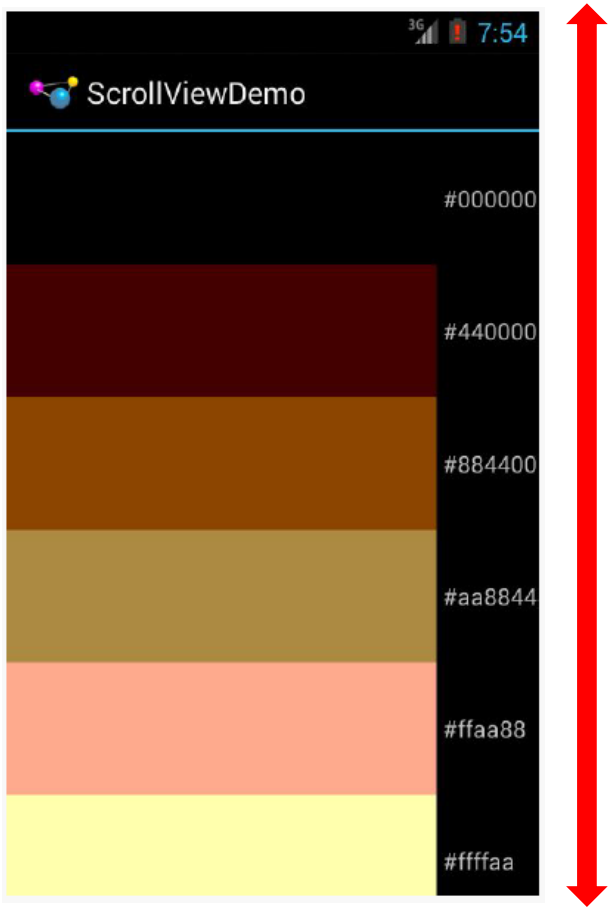
- Specifies "importance“, larger weights takes up more space
- Can set width, height = 0 then
  - weight = percent of height/width you want element to cover

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
  android:layout_width="match_parent"
  android:layout_height="match_parent"
  android:orientation="vertical">

  <Button
    android:layout_width="match_parent"
    android:layout_height="0dip"
    android:layout_weight="50"
    android:text="@string/fifty_percent"/>

  <Button
    android:layout_width="match_parent"
    android:layout_height="0dip"
    android:layout_weight="30"
    android:text="@string/thirty_percent"/>

  <Button
    android:layout_width="match_parent"
    android:layout_height="0dip"
    android:layout_weight="20"
    android:text="@string/twenty_percent"/>

</LinearLayout>
```



Scrolling

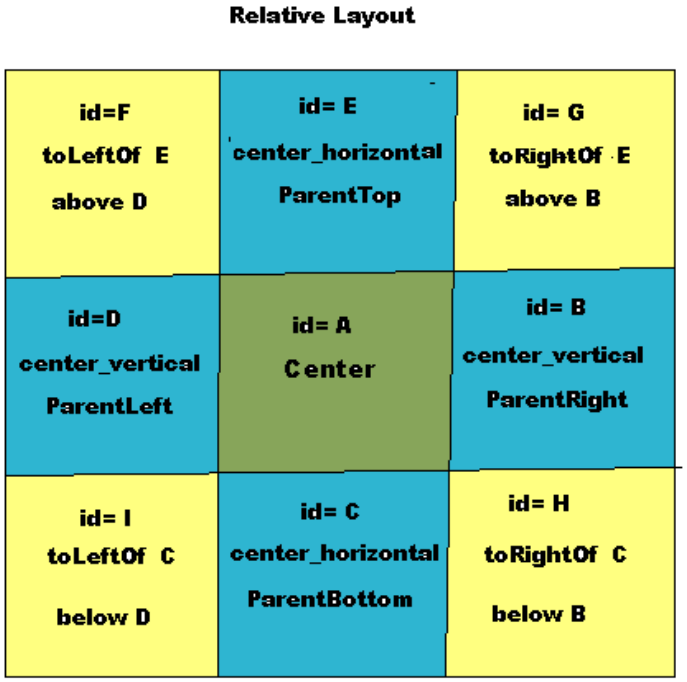
- Phone screens are small, scrolling content helps
- Examples: Scroll through
  - large image
  - Linear Layout with lots of elements
- Views for Scrolling:
  - **ScrollView** for vertical scrolling
  - **HorizontalScrollView**
- Rules:
  - Only one direct child View
  - Child could have many children of its own

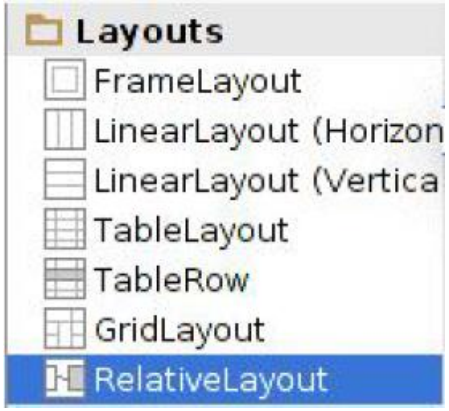



```
<ScrollView
    ...>
    <LinearLayout>
       ....
       <!-- you can have as many Views in here as you want -->
    </LinearLayout>
</ScrollView>
```

RelativeLayout

- First element listed is placed in "center"
- Positions of children specified relative to parent or to each other.





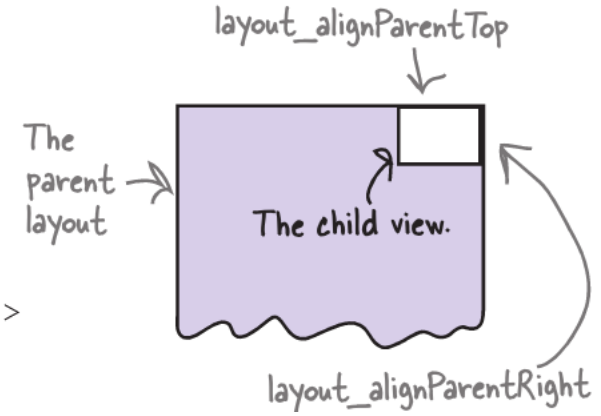
RelativeLayout available In Android Studio palette

Positioning Views Relative to Parent Layout

- Position a view (e.g. button, TextView) relative to its parent
- Example: Button aligned to top, right in a Relative Layout

```
<RelativeLayout ... >
    <Button
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/click_me"
        android:layout_alignParentTop="true"
        android:layout_alignParentRight="true" />
</RelativeLayout>
```

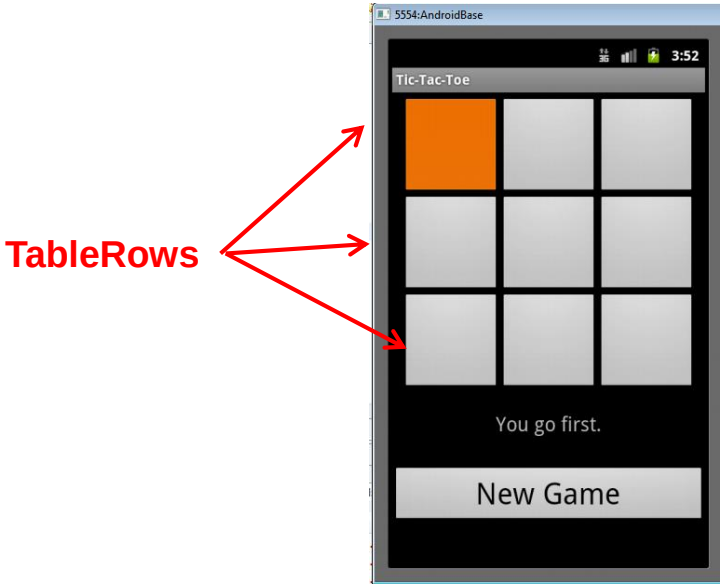
The layout contains the button, so the layout is the button's parent.

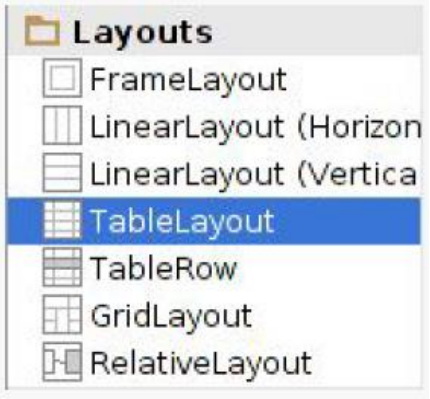


See Head First Android Development page 169 for more examples

Table Layout

- Specify number of rows and columns of views.
- Available in Android Studio palette





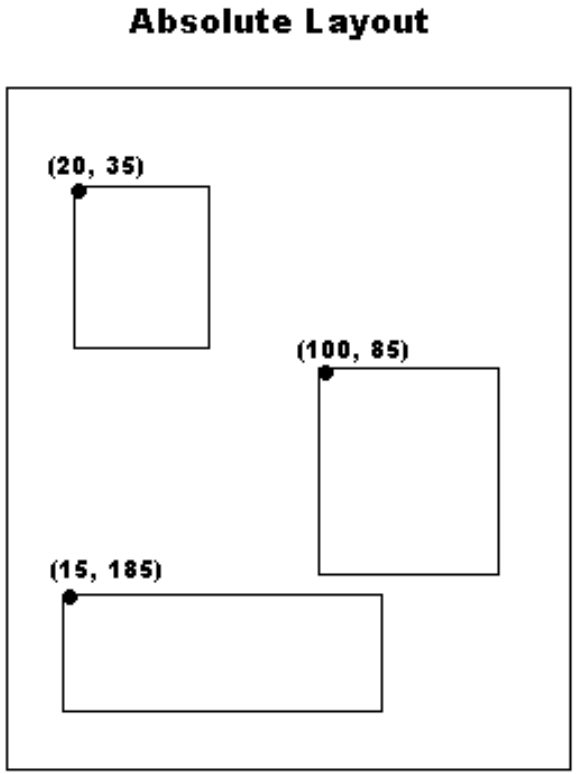
GridLayout

- In TableLayout, Rows can span multiple columns only
- In GridLayout, child views/controls can span multiple rows **AND** columns

- See section “GridLayout Displays Views in a Grid” in Head First Android Development (pg 189)

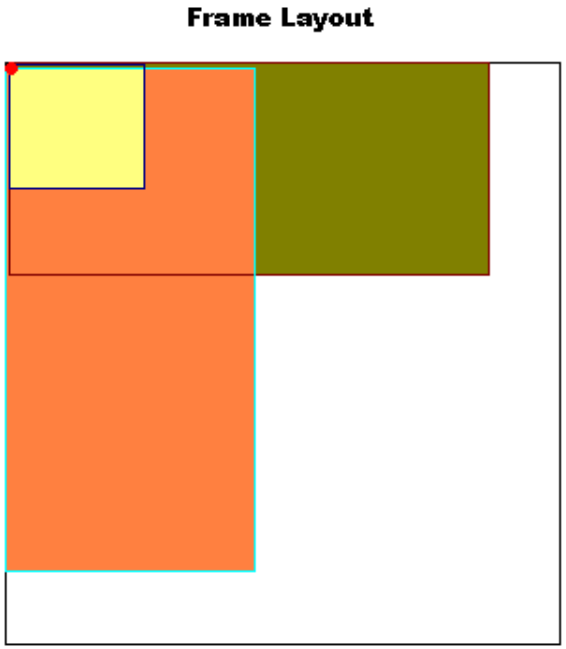
Absolute Layout

- Allows specification of exact x,y coordinates of layout's children.

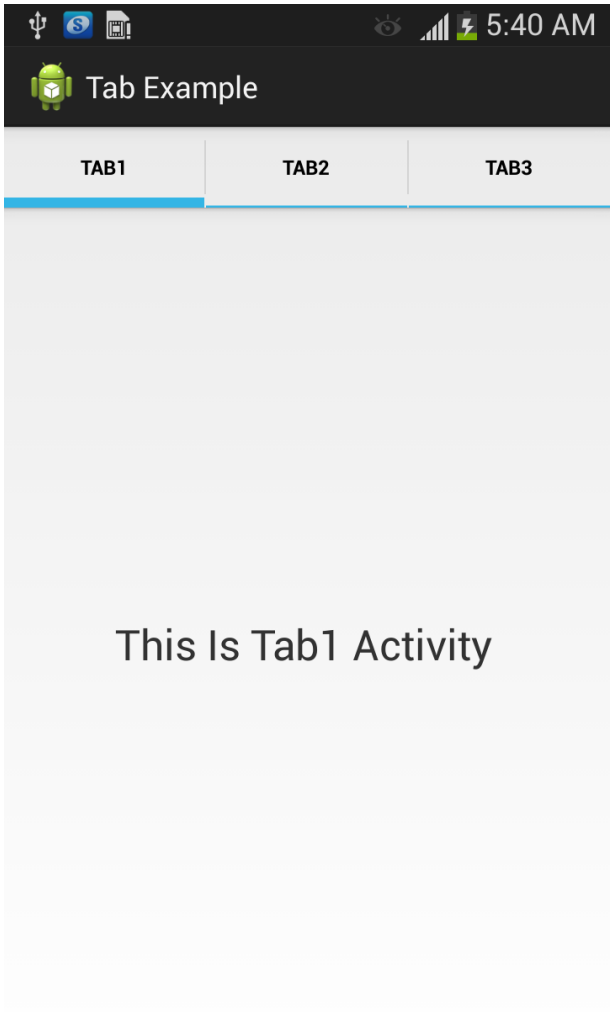


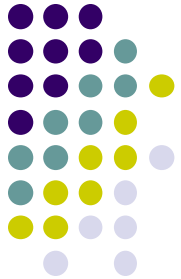
FrameLayout

- child elements pinned to top left corner of layout
- adding a new element / child draws over the last one



Other Layouts: Tabbed Layouts

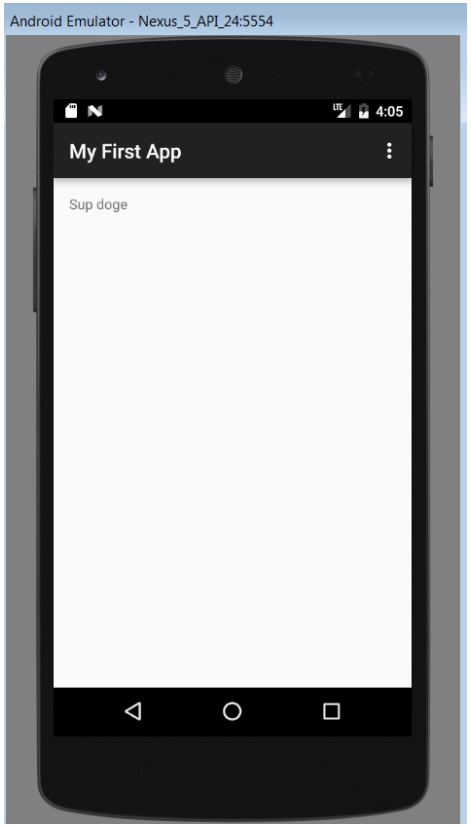


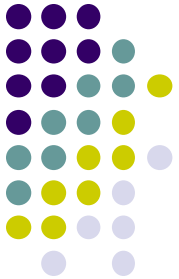


Android Example: My First App (Ref: Head First Android)

My First App

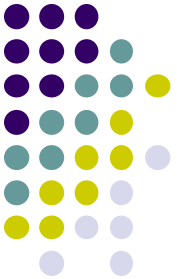
- Hello World program in Head First Android Development (Chapter 1)
- Creates app, types “Sup doge” in a TextView





Android UI Youtube Tutorials

YouTube Tutorial 11 & 12 from thenewBoston

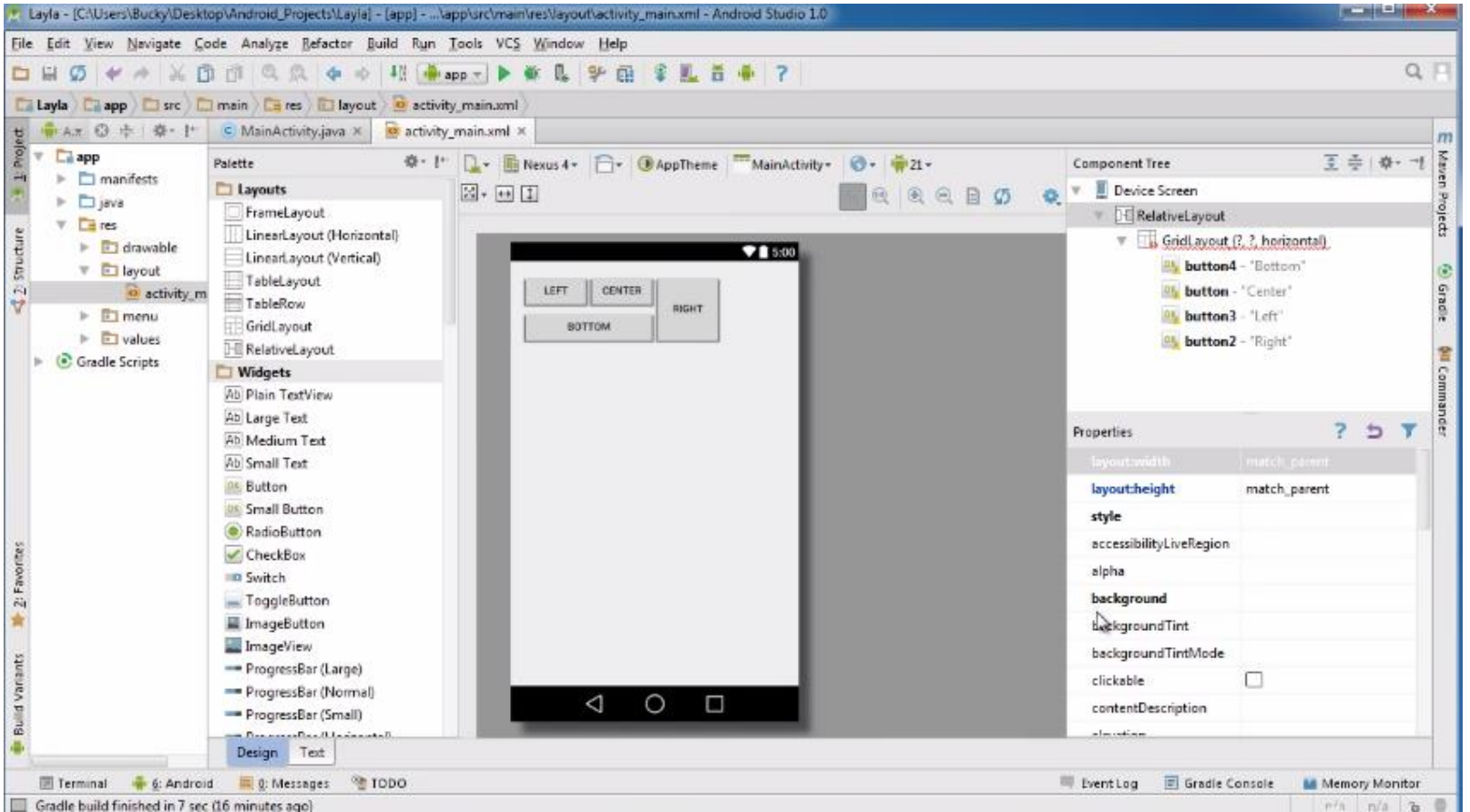


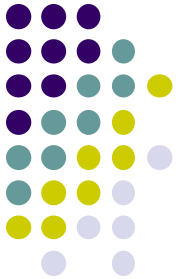
- Tutorial 11: Designing the User Interface [6:19 mins]
  - https://www.youtube.com/watch?v=72mf0rmjNAA
  - Designing the UI
  - Adding activity (screen)
  - Dragging in widgets
  - Changing the text in widgets

- Tutorial 12: More on User Interface [10:24 mins]
  - https://www.youtube.com/watch?v=72mf0rmjNAA
  - Changing text in widgets
  - Changing strings from hardcoded to resources (variables)

Tutorial 17: GridLayout

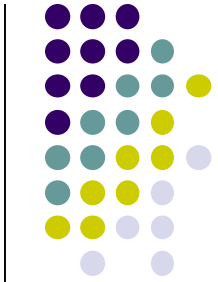
- Tutorial 17: GridLayout [9:40 mins]
  (https://www.youtube.com/watch?v=4bXOr5Rk1dk
  - Creating GridLayout: Layout that places its children in a grid
  - Add widgets (buttons) to GridLayout
  - Format width, height, position of widgets





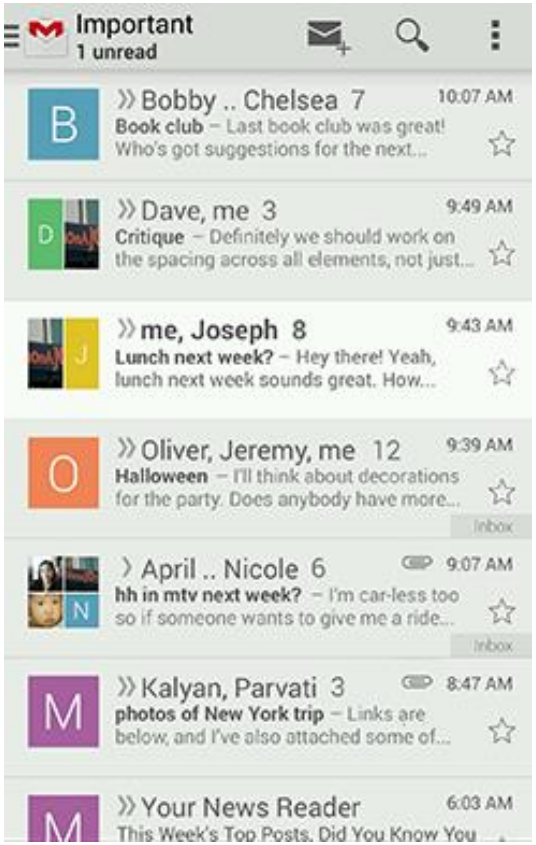
Android Themes

Styles



- Android widgets have properties
  - E.g. Foreground color = red
- **Styles in Android:** specifies properties for multiple attributes of **1 widget**
  - E.g. height, padding, font color, font size, background color
- Similar to Cascaded Style Sheets (CSS) in HTML
- Themes apply styles to **all widgets in an Activity (screen)**
  - E.g. all widgets on a screen can adopt the same font
- Example Android themes: Theme, Theme.holo and Theme.material)

Examples of Themes in Use

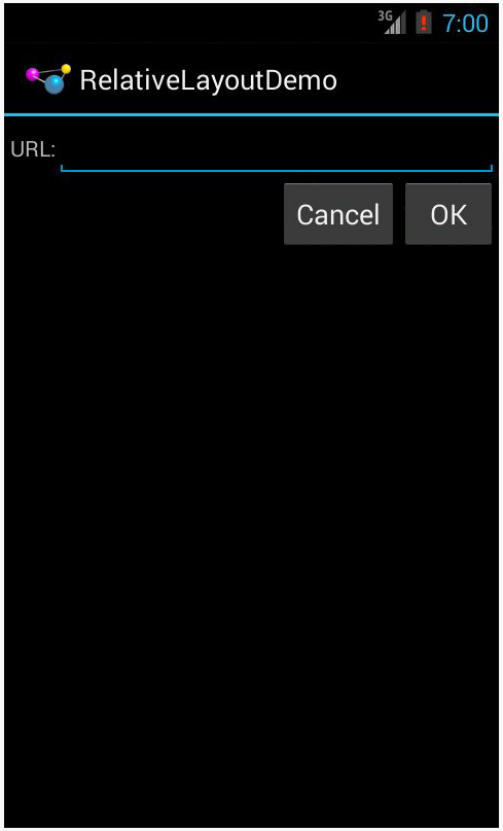


GMAIL in Holo Light

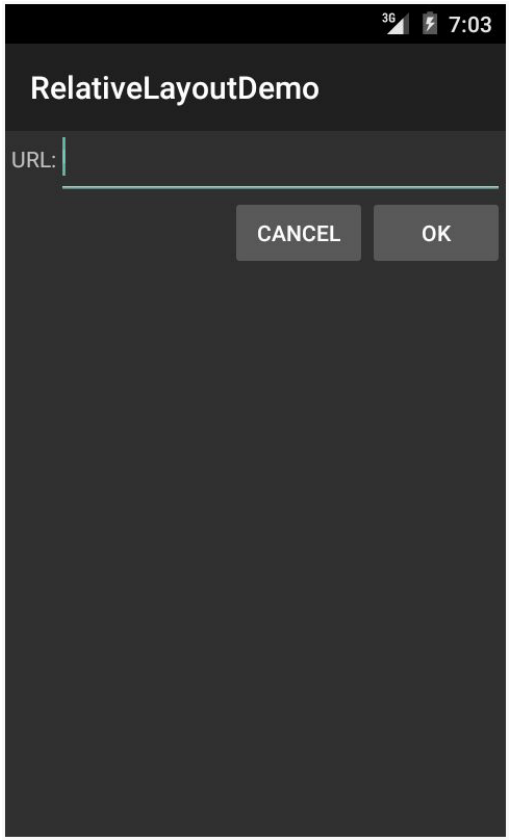
Settings screen in Holo Dark

Default Themes

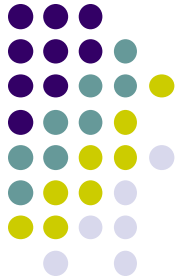
- Many stock themes to choose from
- Android chooses a default theme if you specify none



Theme.Holo: default theme in Android 3.0



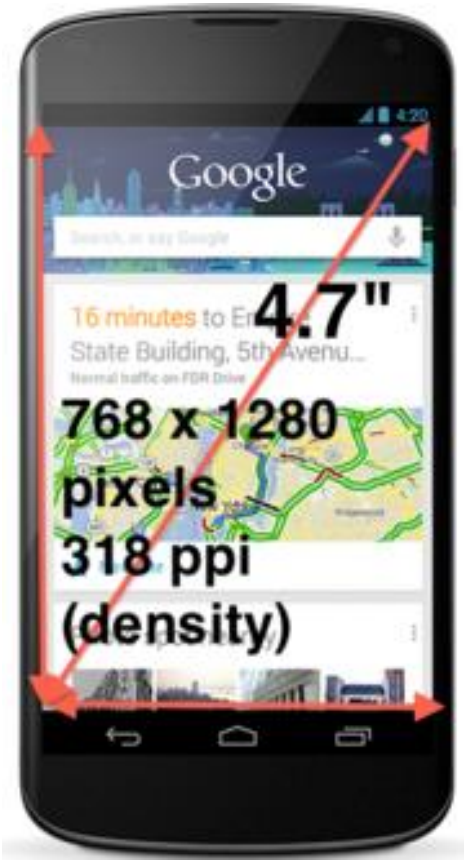
Theme.Material: default theme in Android 5.0



Adding Pictures in Android

Phone Dimensions Used in Android UI

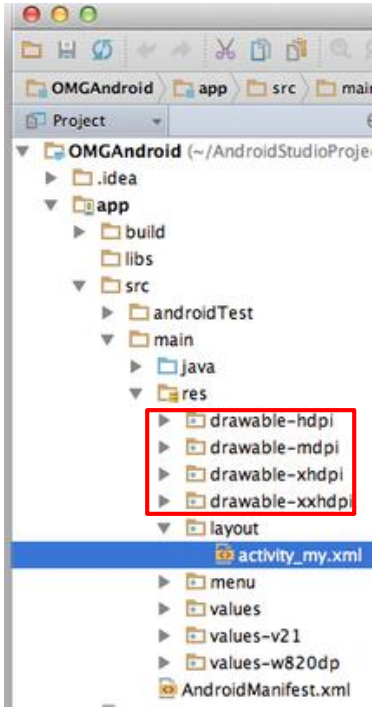
- Physical dimensions (inches) diagonally
  - E.g. Nexus 4 is 4.7 inches diagonally
- Resolution in pixels
  - E.g. Nexus 4 resolution 768 x 1280 pixels
  - Pixels diagonally: Sqrt[(768 x 768) + (1280 x 1280)]
- Pixels per inch (PPI) =
  - Sqrt[(768 x 768) + (1280 x 1280)] / 4.7= 318



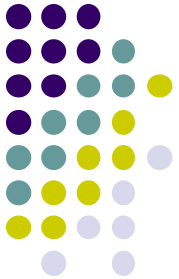
Adding Pictures

- Android supports images in PNG, JPEG and GIF formats
- Put different resolutions of **same image** into different directories
  - **res/drawable-ldpi:** low dpi images (~ 120 dpi of dots per inch)
  - **res/drawable-mdpi:** medium dpi images (~ 160 dpi)
  - **res/drawable-hdpi:** high dpi images (~ 240 dpi)
  - **res/drawable-xhdpi:** extra high dpi images (~ 320 dpi)
  - **res/drawable-xxhdpi:** extra extra high dpi images (~ 480 dpi)
  - **res/drawable-xxxhdpi:** high dpi images (~ 640 dpi)

res/drawable-mdpi
res/drawable-tvdpi
res/drawable-hdpi
res/drawable-xhdpi
res/drawable-xxhdpi
res/drawable-xxxhdpi



Adding Pictures



- Use generic picture name in code (no .png, .jpg, etc)
  - E.g. to reference an image **ic_launcher.png**

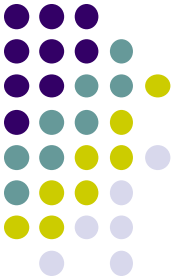
```
<application
    android:allowBackup="false"
    android:icon="@drawable/ic_launcher"
    android:label="@string/app_name"
    android:theme="@style/AppTheme">
```

- At run-time, Android chooses which resolution/directory (e.g. –mdpi) based on phone resolution

- **Image Asset Studio:** generates icons in various densities from original image

  Ref: https://developer.android.com/studio/write/image-asset-studio.html

References



- Android App Development for Beginners videos by Bucky Roberts (thenewboston)
- Ask A Dev, Android Wear: What Developers Need to Know, https://www.youtube.com/watch?v=zTS2NZpLyQg
- Ask A Dev, Mobile Minute: What to (Android) Wear, https://www.youtube.com/watch?v=n5Yjzn3b_aQ
- Busy Coder's guide to Android version 4.4
- CS 65/165 slides, Dartmouth College, Spring 2014
- CS 371M slides, U of Texas Austin, Spring 2014