ĐẠI HỌC BÁCH KHOA HÀ NỘI
VIỆN CÔNG NGHỆ THÔNG TIN VÀ TRUYỀN THÔNG

Mobile Programing

Chapter 1.3. Layouts

Note

- This slides is based on Google Android code labs slides
- Original slides: https://drive.google.com/drive/folders/1eu-LXxiHocSktGYpG04PfE9Xmr_pBY5P

Contents

- Views, view groups, and view hierarchy
- The layout editor and `ConstraintLayout`
- Event handling
- Resources and measurements

Views

Everything you see is a view

If you look at your mobile device, every user interface element that you see is a **`View`**.

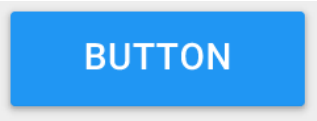
What is a view?

`View` subclasses are basic user interface building blocks

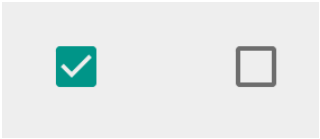
- Display text (`TextView` class), edit text (`EditText` class)
- Buttons (`Button` class), `menus`, other controls
- Scrollable (`ScrollView`, `RecyclerView`)
- Show images (`ImageView`)
- Group views (`ConstraintLayout` and `LinearLayout`)

Examples of view subclasses

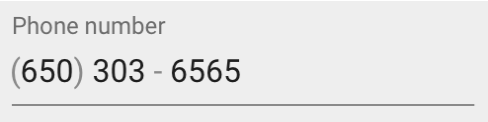
Button



CheckBox



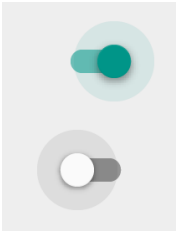
EditText



RadioButton

Slider

Switch



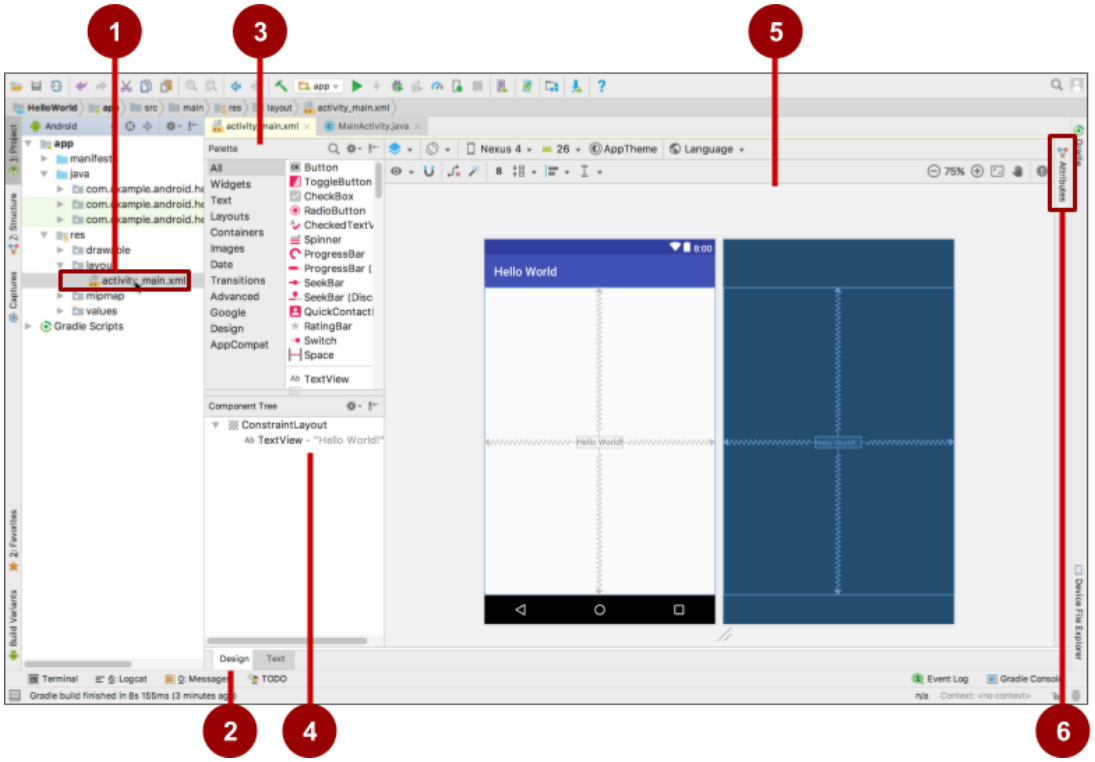
View attributes

- Color, dimensions, positioning
- May have focus (e.g., selected to receive user input)
- May be interactive (respond to user clicks)
- May be visible or not
- Relationships to other views

Create views and layouts

- Android Studio layout editor: visual representation of XML
- XML editor
- Java code

Android Studio layout editor



1. XML layout file
2. **Design** and **Text** tabs
3. **Palette** pane
4. **Component Tree**
5. Design and blueprint panes
6. **Attributes** tab

View defined in XML

```
<TextView
        android:id="@+id/show_count"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:background="@color/myBackgroundColor"
        android:text="@string/count_initial_value"
        android:textColor="@color/colorPrimary"
        android:textSize="@dimen/count_text_size"
        android:textStyle="bold"
/>
```

View attributes in XML

android:<property_name>="<property_value>"

Example: android:layout_width="match_parent"

android:<property_name>="@<resource_type>/resource_id"

Example: android:text="@string/button_label_next"

android:<property_name>="@+id/view_id"

Example: android:id="@+id/show_count"

Create View in Java code

context

In an `Activity`:

```
TextView myText = new TextView(this);
myText.setText("Display this text!");
```

What is the context?

- `Context` is an interface to global information about an application environment
- Get the context:

```
Context context =
getApplicationContext();
```

- An `Activity` is its own context:

```
TextView myText = new TextView(this);
```

Custom views

- Over 100 (!) different types of views available from the Android system, all children of the `View` class
- If necessary, create custom views by subclassing existing views or the `View` class

ViewGroup and View hierarchy

ViewGroup contains "child" views

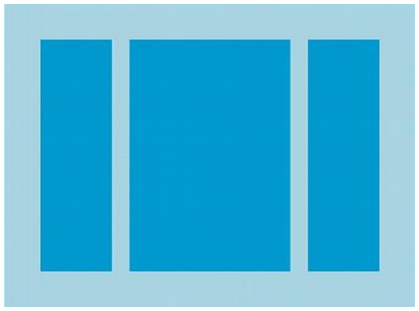
- `ConstraintLayout`: Positions UI elements using constraint connections to other elements and to the layout edges
- `ScrollView`: Contains one element and enables scrolling
- `RecyclerView`: Contains a list of elements and enables scrolling by adding and removing elements dynamically

ViewGroups for layouts

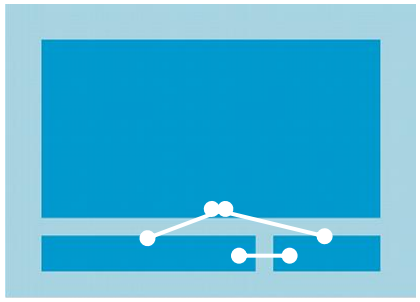
Layouts

- are specific types of `ViewGroups` (subclasses of `ViewGroup`)
- contain child views
- can be in a row, column, grid, table, absolute

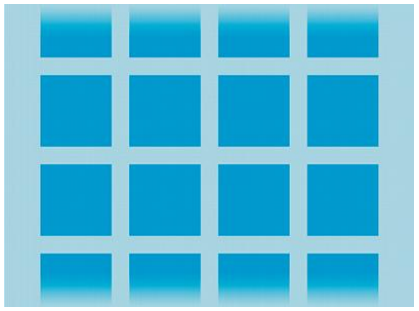
Common Layout Classes



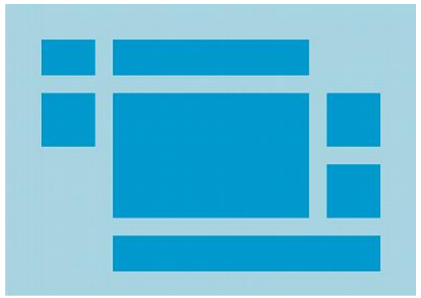
LinearLayout



ConstraintLayout



GridLayout



TableLayout

Common Layout Classes

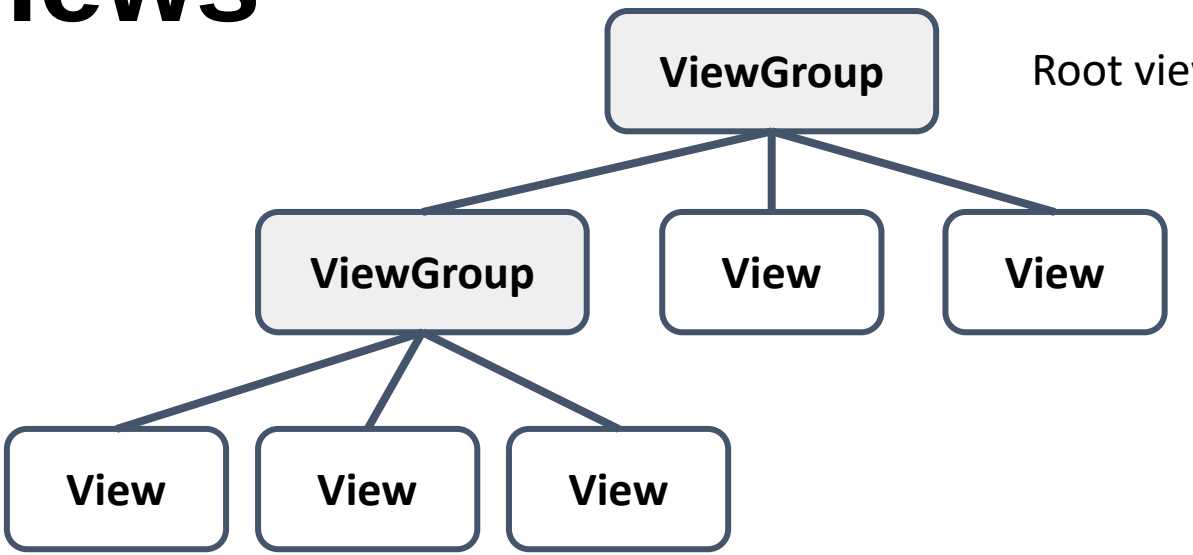
- `ConstraintLayout`: Connect views with constraints
- `LinearLayout`: Horizontal or vertical row
- `RelativeLayout`: Child views relative to each other
- `TableLayout`: Rows and columns
- `FrameLayout`: Shows one child of a stack of children

Class hierarchy vs. layout hierarchy

- `View` class-hierarchy is standard object-oriented class inheritance
  - For example, `Button` is-a `TextView` is-a `View` is-an Object
  - Superclass-subclass relationship

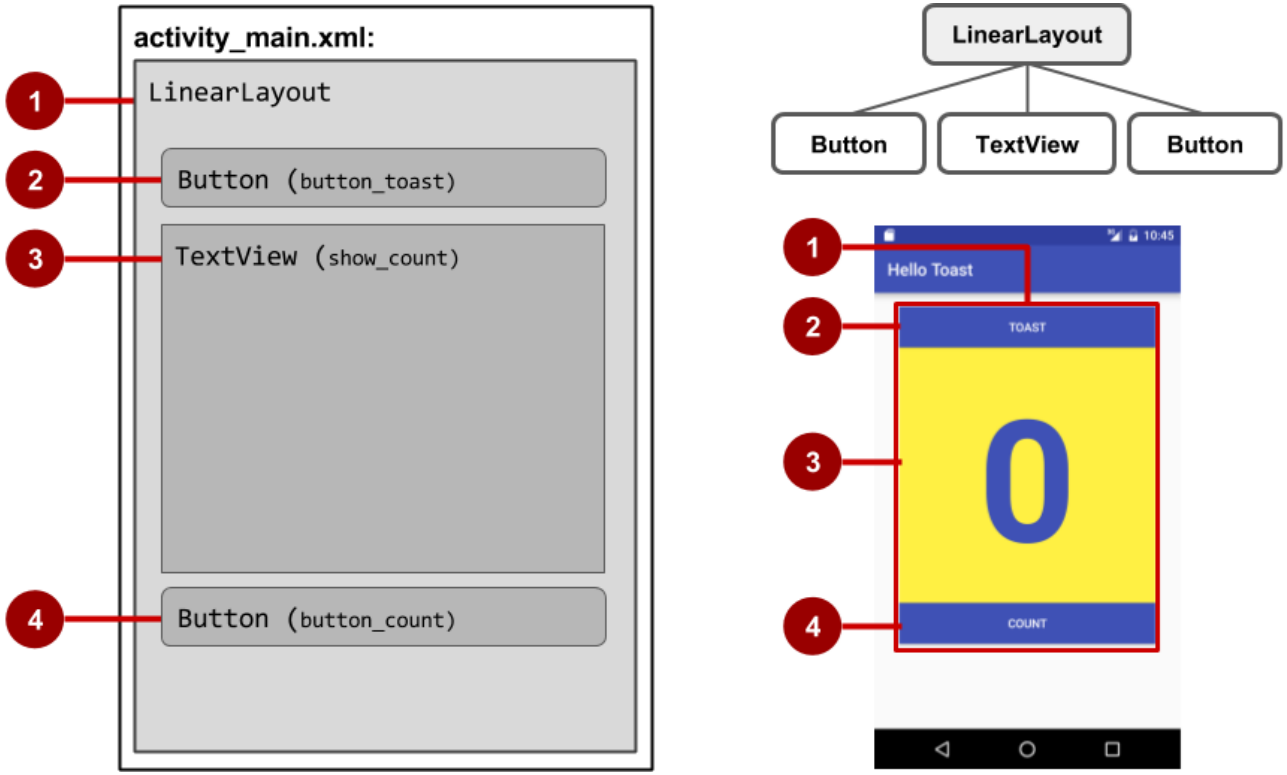
- Layout hierarchy is how views are visually arranged
  - For example, `LinearLayout` can contain `Buttons` arranged in a row
  - Parent-child relationship

Hierarchy of viewgroups and views

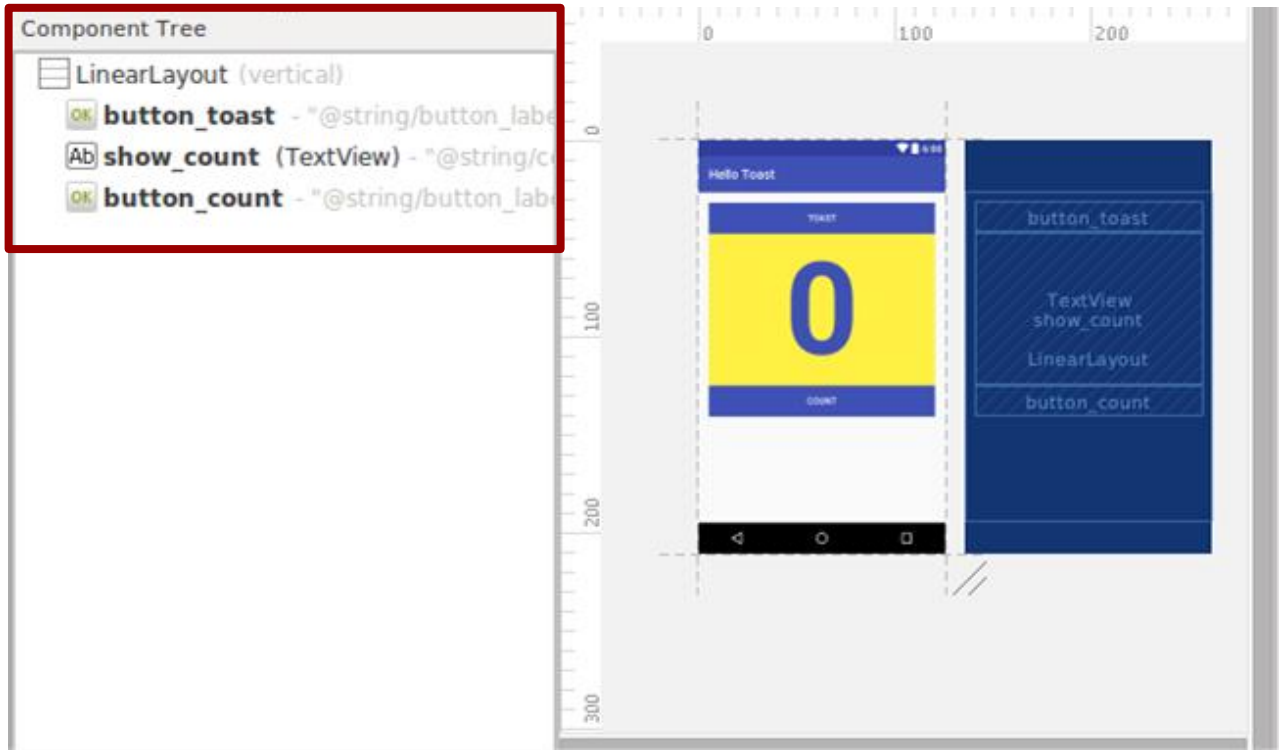


Root view is always a `ViewGroup`

View hierarchy and screen layout



View hierarchy in the layout editor



Layout created in XML

```
<LinearLayout
  android:orientation="vertical"
  android:layout_width="match_parent"
  android:layout_height="match_parent">
    <Button
        ... />
    <TextView
        ... />
    <Button
        ... />
</LinearLayout
```

Layout created in Java Activity code

```
LinearLayout linearL = new
LinearLayout(this);
linearL.setOrientation(LinearLayout.VERTICAL
);

TextView myText = new TextView(this);
myText.setText("Display this text!");

linearL.addView(myText);
setContentView(linearL);
```

Set width and height in Java code

Set the width and height of a view:

```
LinearLayout.LayoutParams layoutParams =
  new Linear.LayoutParams(
     LayoutParams.MATCH_PARENT,
     LayoutParams.MATCH_CONTENT);
myView.setLayoutParams(layoutParams);
```

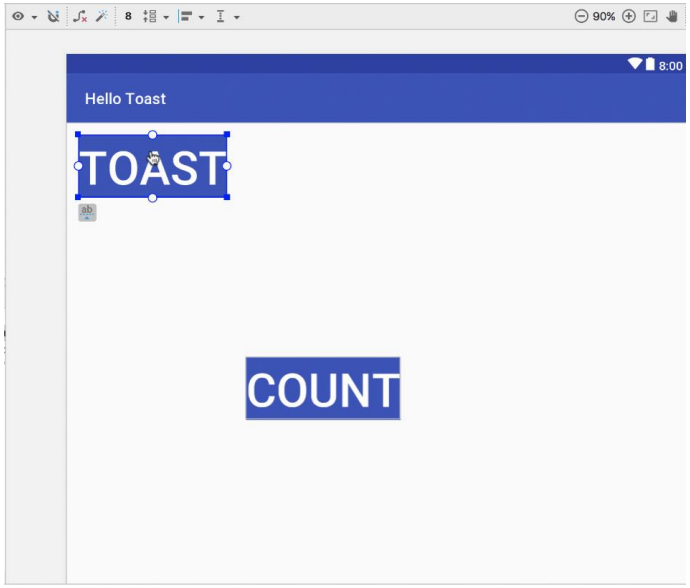
Best practices for view hierarchies

- Arrangement of view hierarchy affects app performance
- Use smallest number of simplest views possible
- Keep the hierarchy flat—limit nesting of views and view groups

The layout editor and Constraint Layout

The layout editor with ConstraintLayout

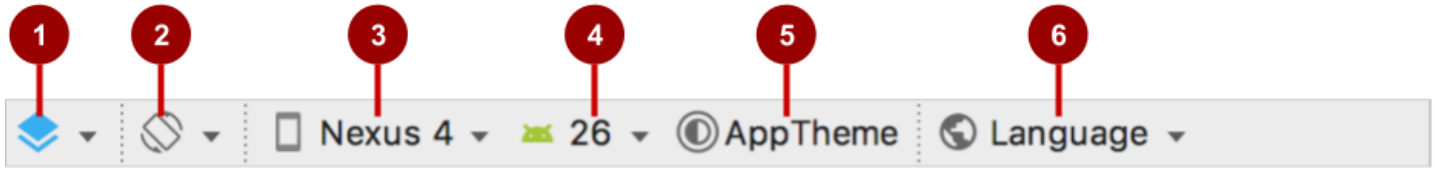
- Connect UI elements to parent layout
- Resize and position elements
- Align elements to others
- Adjust margins and dimensions
- Change attributes



What is ConstraintLayout?

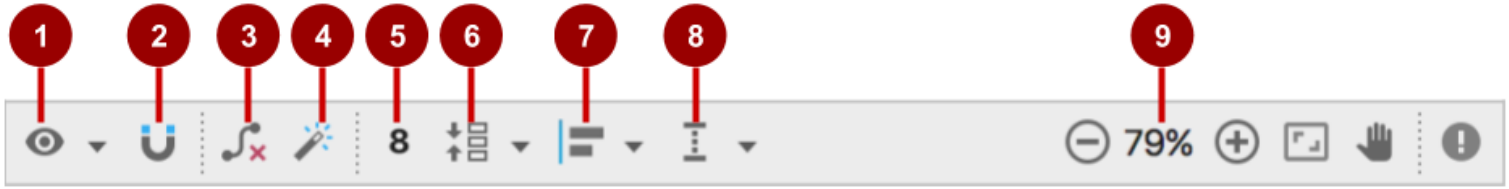
- Default layout for new Android Studio project
- `ViewGroup` that offers flexibility for layout design
- Provides constraints to determine positions and alignment of UI elements
- Constraint is a connection to another view, parent layout, or invisible guideline

Layout editor main toolbar



1. Select Design Surface: Design and Blueprint panes
2. Orientation in Editor: Portrait and Landscape
3. Device in Editor: Choose device for preview
4. API Version in Editor: Choose API for preview
5. Theme in Editor: Choose theme for preview
6. Locale in Editor: Choose language/locale for preview

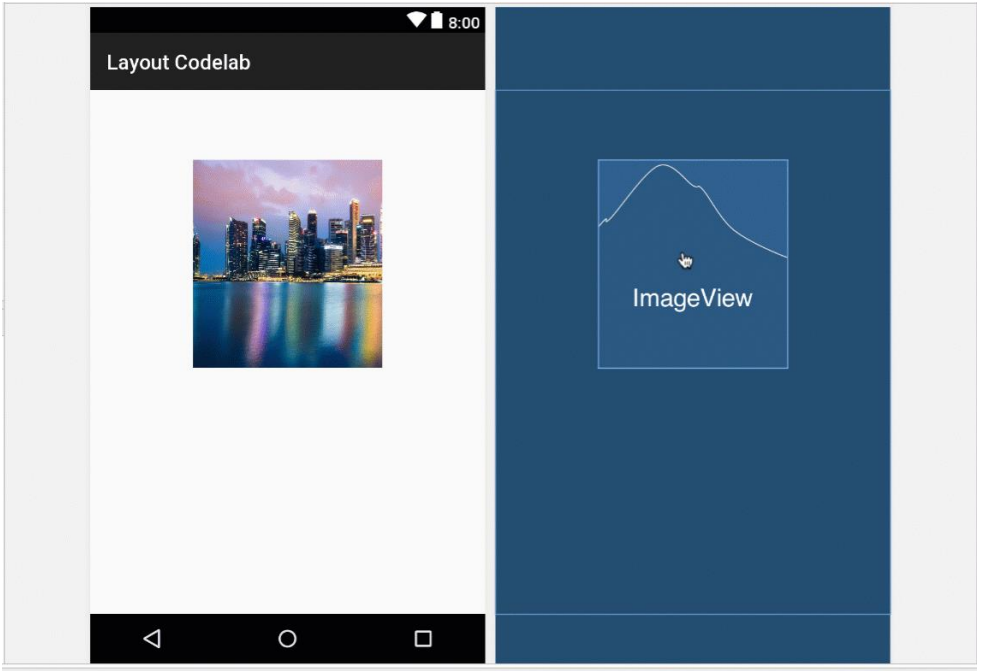
ConstraintLayout toolbar in layout editor



1. Show: Show Constraints and Show Margins
2. Autoconnect: Enable or disable
3. Clear All Constraints: Clear all constraints in layout
4. Infer Constraints: Create constraints by inference
5. Default Margins: Set default margins
6. Pack: Pack or expand selected elements
7. Align: Align selected elements
8. Guidelines: Add vertical or horizontal guidelines
9. Zoom controls: Zoom in or out

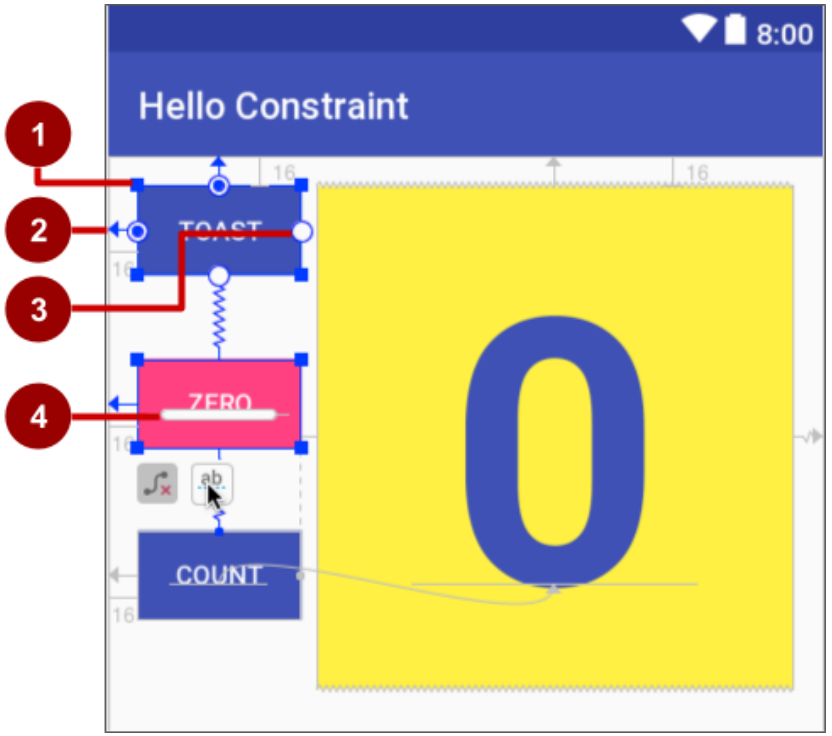
Autoconnect

- Enable Autoconnect in toolbar if disabled
- Drag element to any part of a layout
- Autoconnect generates constraints against parent layout



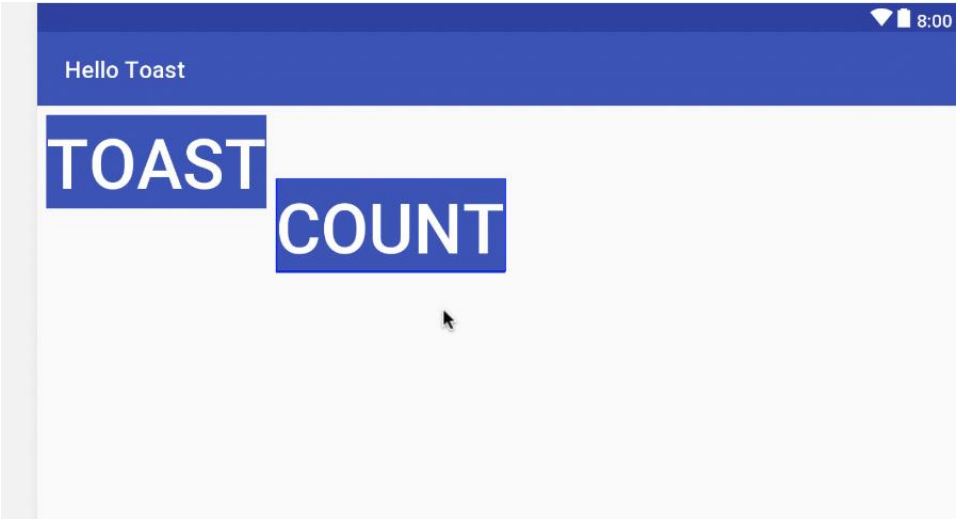
ConstraintLayout handles

1. Resizing handle
2. Constraint line and handle
3. Constraint handle
4. Baseline handle



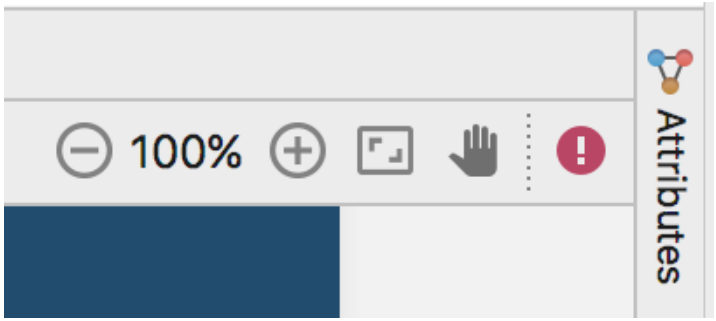
Align elements by baseline

1. Click the baseline constraint button
2. Drag from baseline to other element's baseline



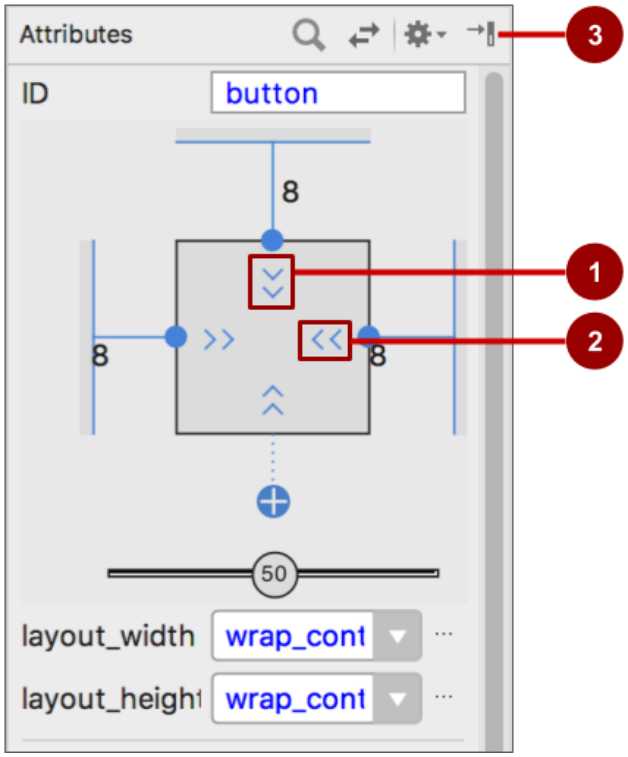
Attributes pane

- Click the Attributes tab
- Attributes pane includes:
  - Margin controls for positioning
  - Attributes such as `layout_width`



Attributes pane view inspector

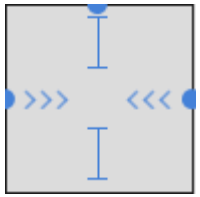
1. Vertical view size control specifies `layout_height`
2. Horizontal view size control specifies `layout_width`
3. Attributes pane close button



Layout_width and layout_height

`layout_width` and `layout_height` change with size controls

- `match_constraint`: Expands element to fill its parent
- `wrap_content`: Shrinks element to enclose content
- Fixed number of `dp` (density-independent pixels)

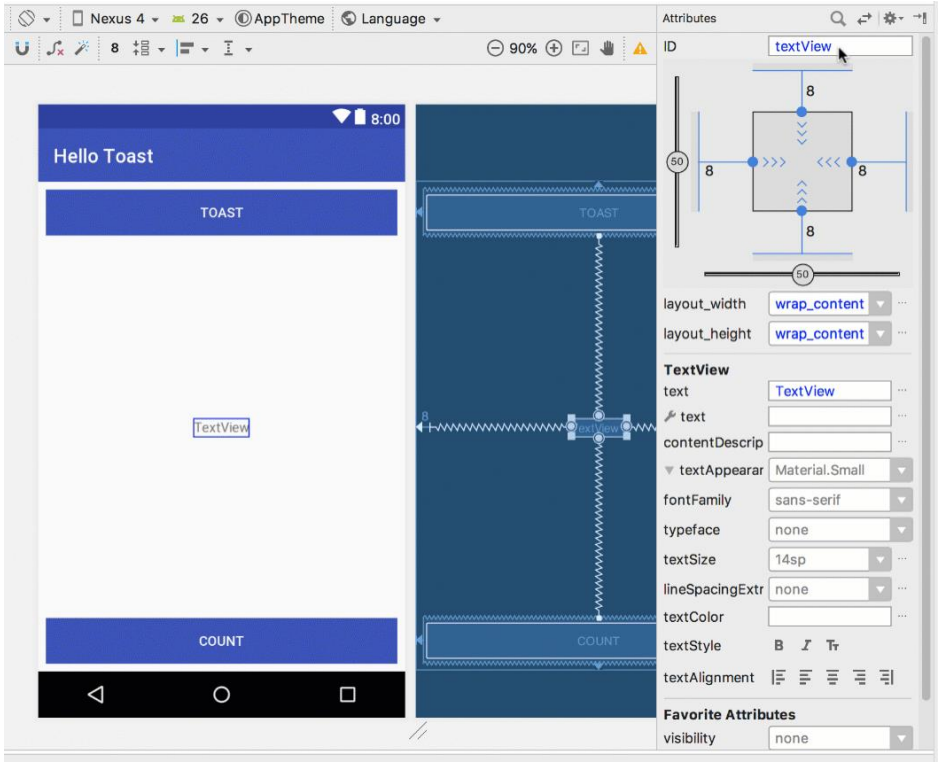


Set attributes

To view and edit all attributes for element:

1. Click **Attributes** tab
2. Select element in design, blueprint, or Component Tree
3. Change most-used attributes
4. Click  at top or **View more attributes** at bottom to see and change more attributes

Set attributes example: TextView

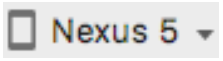


Preview layouts

Preview layout with horizontal/vertical orientation:

1. Click Orientation in Editor button 
2. Choose **Switch to Landscape** or **Switch to Portrait**

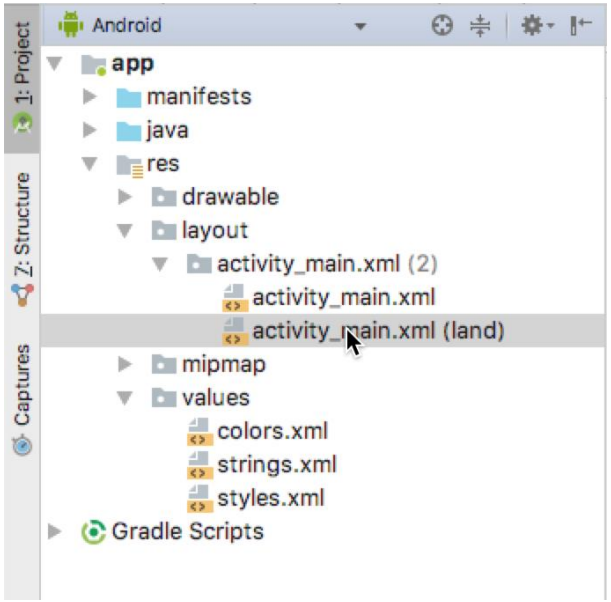
Preview layout with different devices:

1. Click Device in Editor button 

2. Choose device

Create layout variant for landscape

1. Click Orientation in Editor button 
2. Choose **Create Landscape Variation**
3. Layout variant created: `activity_main.xml (land)`
4. Edit the layout variant as needed



Create layout variant for tablet

1. Click Orientation in Layout Editor 
2. Choose **Create layout x-large Variation**
3. Layout variant created: `activity_main.xml (xlarge)`
4. Edit the layout variant as needed

Event Handling

Events

Something that happens

- In UI: Click, tap, drag
- Device: DetectedActivity such as walking, driving, tilting
- Events are "noticed" by the Android system

Event Handlers

Methods that do something in response to a click

- A method, called an **event handler**, is triggered by a specific event and does something in response to the event

Attach in XML and implement in Java

Attach handler to view in XML layout:

```
android:onClick="showToast"
```

Implement handler in Java activity:

```
public void showToast(View view) {
  String msg = "Hello Toast!";
  Toast toast = Toast.makeText(
        this, msg, duration);
  toast.show();
  }
}
```

Alternative: Set click handler in Java

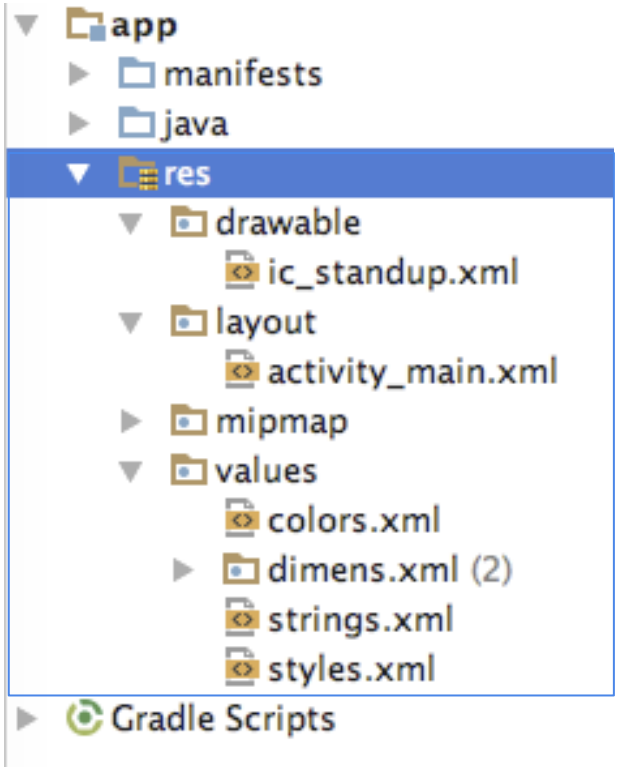
```
final Button button = (Button) findViewById(R.id.button_id);
button.setOnClickListener(new View.OnClickListener() {
    public void onClick(View v) {
        String msg = "Hello Toast!";
        Toast toast = Toast.makeText(this, msg, duration);
        toast.show();
        }
    });
```

Resources and measurements

Resources

- Separate static data from code in your layouts.
- Strings, dimensions, images, menu text, colors, styles
- Useful for localization

Where are the resources in your project?



resources and resource files stored in **res** folder

Refer to resources in code

- Layout:

  `R.layout.activity_main`

  `setContentView(R.layout.activity_main);`

- View:

  `R.id.recyclerview`

  `rv = (RecyclerView) findViewById(R.id.recyclerview);`

- String:

  In Java: `R.string.title`

  In XML: `android:text="@string/title"`

Measurements

- Density-independent Pixels (`dp`): for Views
- Scale-independent Pixels (`sp`): for text

Don't use device-dependent or density-dependent units:

- Actual Pixels (`px`)
- Actual Measurement (`in`, `mm`)
- Points - typography 1/72 inch (`pt`)

Learn more

Learn more

Views:

- `View` class documentation
- device independent pixels
- `Button` class documentation
- `TextView` class documentation

Layouts:

- developer.android.com Layouts
- Common Layout Objects

Learn even more

Resources:

- Android resources
- `Color` class definition
- `R.color` resources
- Supporting Different Densities
- Color Hex Color Codes

Other:

- Android Studio documentation
- Image Asset Studio
- UI Overview
- Vocabulary words and concepts glossary
- Model-View-Presenter (MVP) architecture pattern
- Architectural patterns

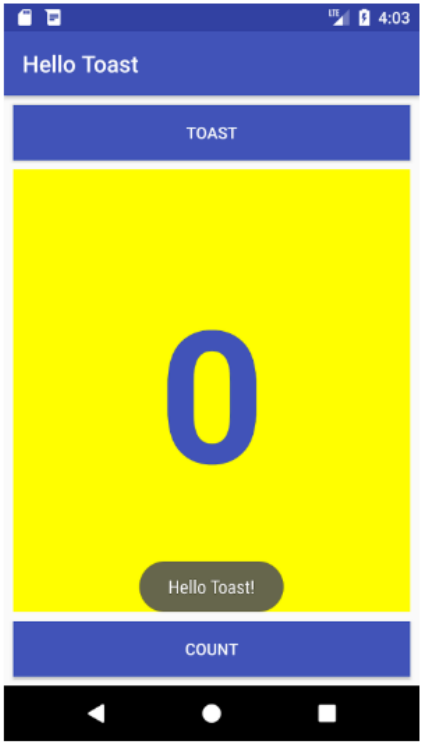
What's Next?

- Concept Chapter: 1.2 Layouts and resources for the UI
- Practicals:
  - 1.2A : Your first interactive UI
  - 1.2B : The layout editor

END

CODELABS

App Overview



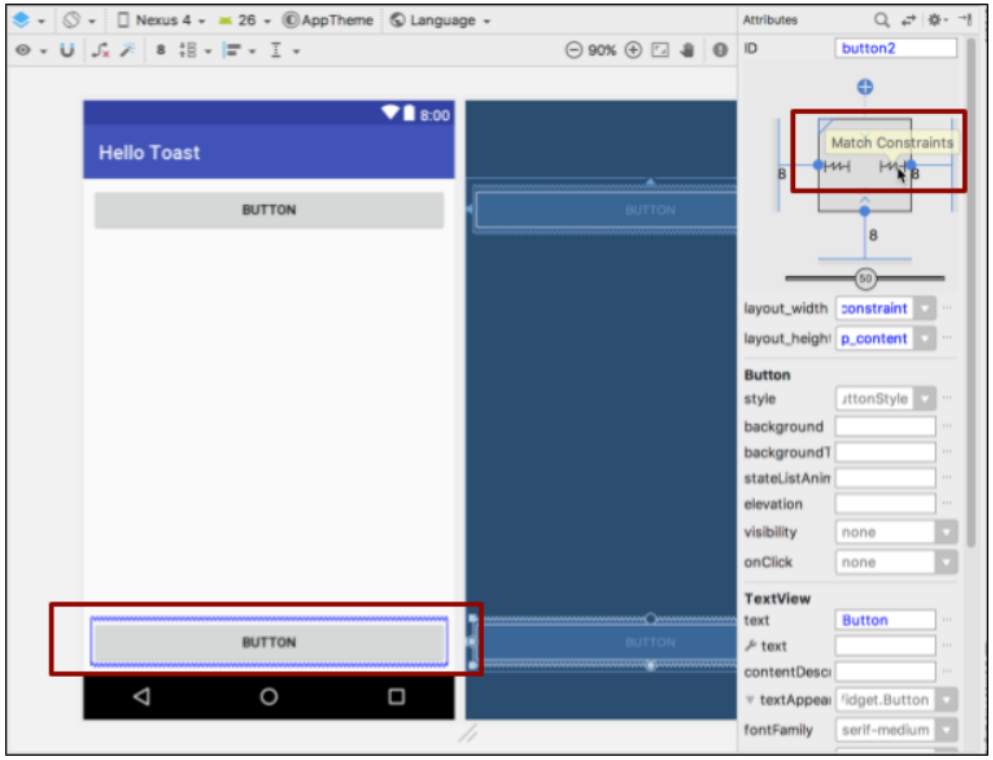
Task 1: Create and explore a project

Attribute	Value
Application Name	**Hello Toast**
Company Name	**com.example.android** (or your own domain)
Phone and Tablet Minimum SDK	**API15: Android 4.0.3 IceCreamSandwich**
Template	**Empty Activity**
Generate Layout file box	Selected
Backwards Compatibility box	Selected

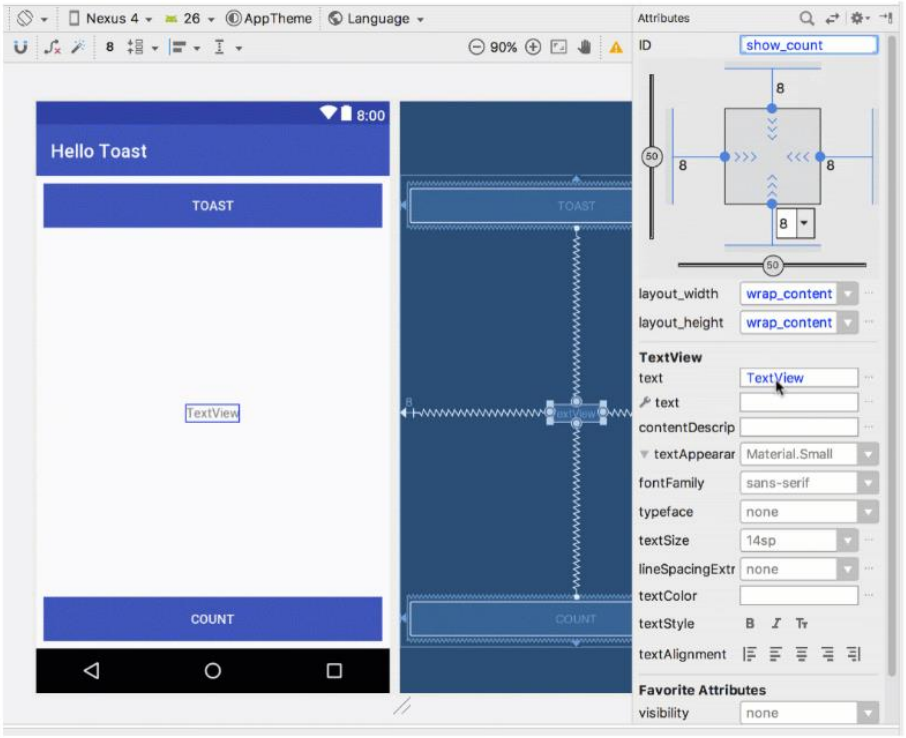
Task 2: Add View elements

1. Textview
2. Button
3. The second button

Task 3: Change UI element attributes



Task 4: Add a TextView



Task 5: Edit layout in XML

activity_main.xml | MainActivity.java

android.support.constraint.ConstraintLayout | Button

```
<?xml version="1.0" encoding="utf-8"?>
<android.support.constraint.ConstraintLayout xmlns:android="http://schemas.android.com/apk/res/androi
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    tools:context="com.example.android.hellotoast.MainActivity">

    <Button
        android:id="@+id/button_toast"
        android:layout_width="0dp"
        android:layout_height="wrap_content"
        android:layout_marginEnd="8dp"
        android:layout_marginStart="8dp"
        android:layout_marginTop="8dp"
        android:background="@color/colorPrimary"
        android:text="Toast"
        android:textColor="@android:color/white"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent" />

    <Button
        android:id="@+id/button_count"
        android:layout_width="0dp"
        android:layout_height="wrap_content"
        android:layout_marginBottom="8dp"
        android:layout_marginEnd="8dp"
        android:layout_marginStart="8dp"
        android:background="@color/colorPrimary"
        android:text="Count"
        android:textColor="@android:color/white"
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintStart_toStartOf="parent" />

    <TextView
        android:id="@+id/show_count"
        android:layout_width="0dp"
        android:layout_height="0dp"
        android:layout_marginBottom="8dp"
```

Hardcoded string "Toast", should use @string resource more... (⌘F1)

```
<resources>
    <string name="app_name">Hello Toast</string>
    <string name="button_label_toast">Toast</string>
    <string name="button_label_count">Count</string>
    <string name="count_initial_value">0</string>
    <string name="toast_message">Hello Toast!</string>
</resources>
```

Task 6: Click Handler

```
<Button
        android:id="@+id/button_toast"
        android:layout_width="0dp"
        android:layout_height="wrap_content"
        android:layout_marginEnd="8dp"
        android:layout_marginStart="8dp"
        android:layout_marginTop="8dp"
        android:background="@color/colorPrimary"
        android:text="@string/button_label_toast"
        android:textColor="@android:color/white"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        android:onClick="showToast"/>
```

```
public void showToast(View view) {
    Toast toast = Toast.makeText(this, R.string.toast_message,
                                 Toast.LENGTH_SHORT);
    toast.show();
}
```