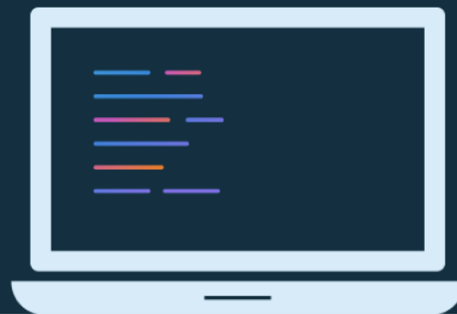




# Lesson 5: Layouts



# About this lesson

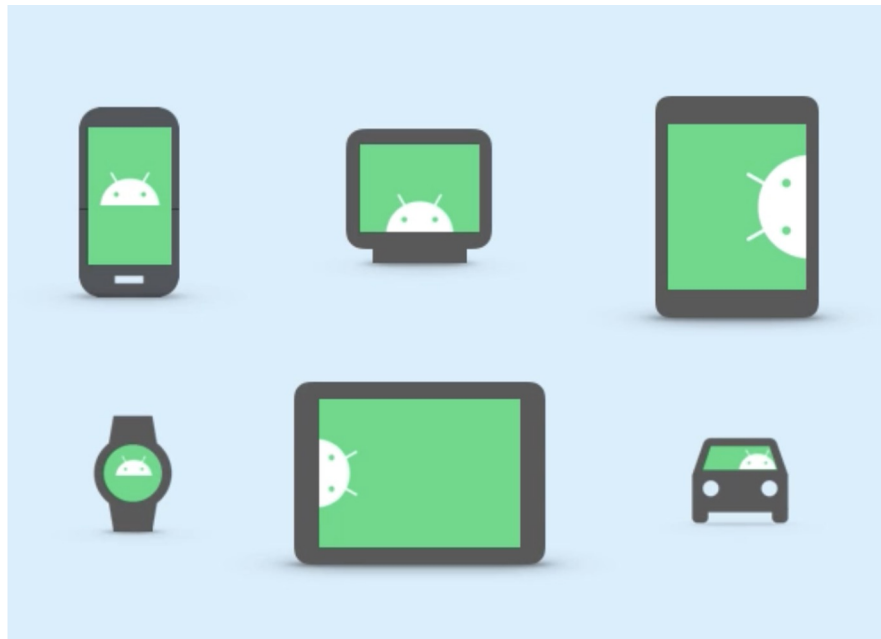
## Lesson 5: Layouts

- [Layouts in Android](#)
- [ConstraintLayout](#)
- [Additional topics for ConstraintLayout](#)
- [Data binding](#)
- [Displaying lists with RecyclerView](#)
- [Summary](#)

# Layouts in Android

# Android devices

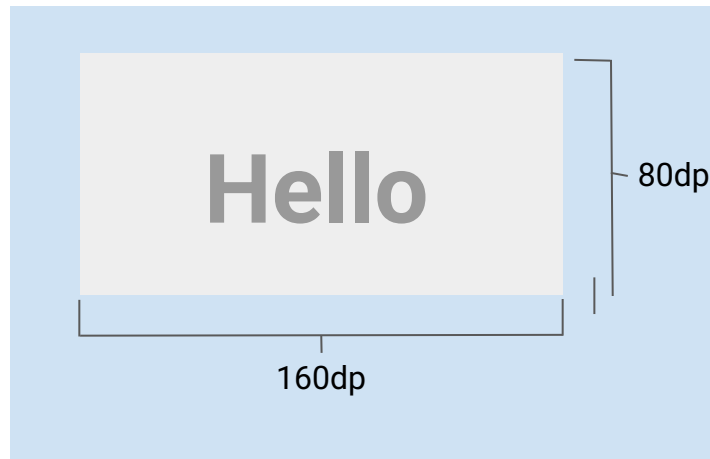
- Android devices come in many different form factors.
- More and more pixels per inch are being packed into device screens.
- Developers need the ability to specify layout dimensions that are consistent across devices.



# Density-independent pixels (dp)

Use dp when specifying sizes in your layout, such as the width or height of views.

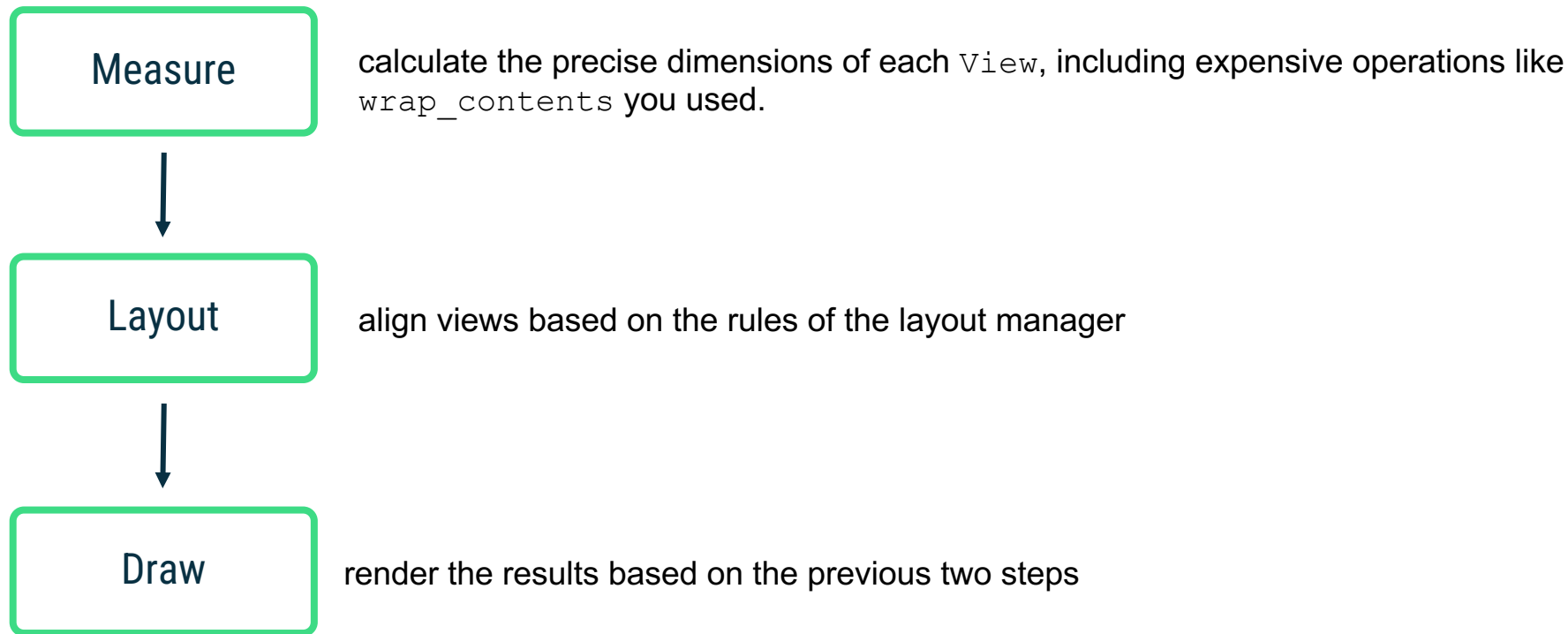
- Density-independent pixels (dp) take screen density into account.
- Android views are measured in density-independent pixels.
- $$\text{dp} = \frac{\text{width in pixels} * 160}{\text{screen density}}$$



# Screen-density buckets

Density qualifier	Description	DPI estimate
ldpi (mostly unused)	Low density	~120dpi
mdpi (baseline density)	Medium density	~160dpi
hdpi	High density	~240dpi
xhdpi	Extra-high density	~320dpi
xxhdpi	Extra-extra-high density	~480dpi
xxxhdpi	Extra-extra-extra-high density	~640dpi

# Android View rendering cycle

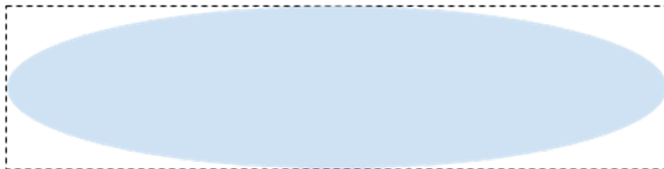


# Drawing region

What we see:



How it's drawn:

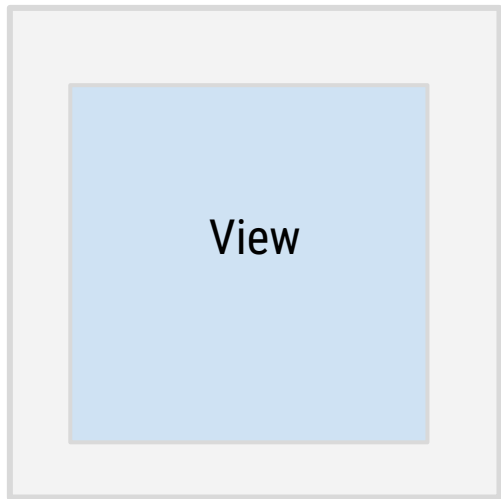


No matter the shape of a widget, when it comes to drawing it on-screen, the draw calls are bounded by **rectangles**, which serve as an invisible border to the `View`.

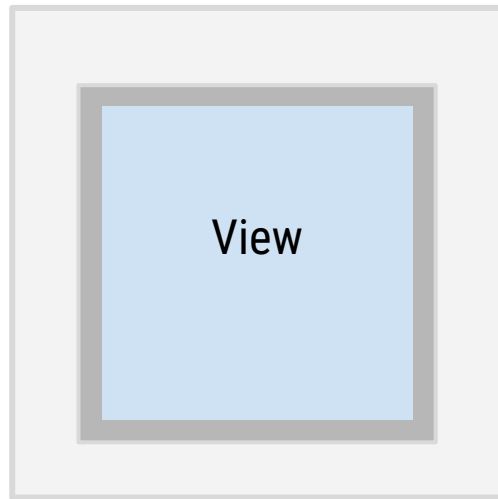


# View margins and padding

View with margin



View with margin and padding



# ConstraintLayout

# Deeply nested layouts are costly

- Deeply nested ViewGroups require more computation
- Views may be measured multiple times
- Can cause UI slowdown and lack of responsiveness

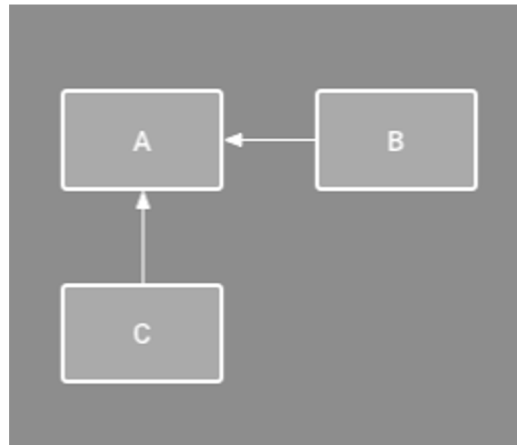
Use ConstraintLayout to avoid some of these issues!

# What is ConstraintLayout?

- Recommended default layout for Android
- Solves costly issue of too many nested layouts, while allowing complex behavior
- Position and size views within it using a set of constraints

# What is a constraint?

A restriction or limitation on the properties of a View that the layout attempts to respect



# Relative positioning constraints

Can set up a constraint relative to the parent container

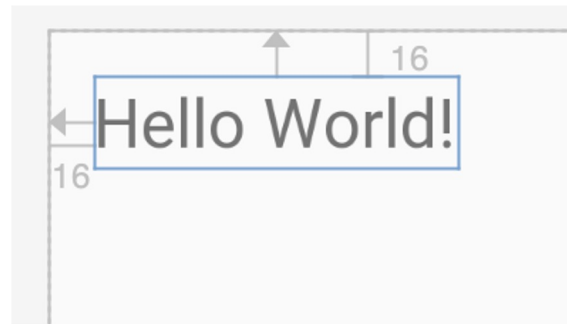
## Format:

```
layout_constraint<SourceConstraint>_to<TargetConstraint>Of
```

Example attributes on a TextView:

```
app:layout_constraintTop_toTopOf="parent"
```

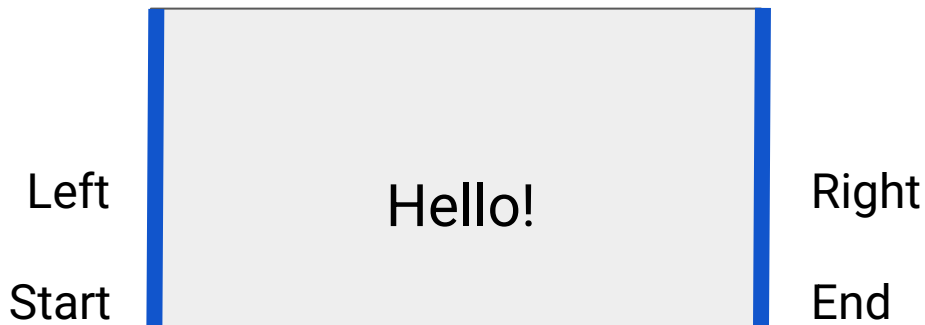
```
app:layout_constraintLeft_toLeftOf="parent"
```



# Relative positioning constraints



# Relative positioning constraints





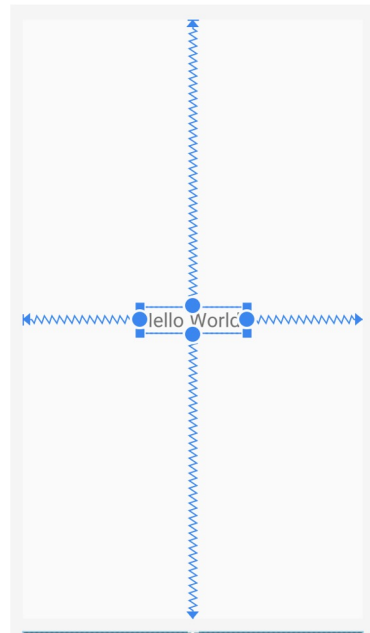
# Simple ConstraintLayout example

```
<androidx.constraintlayout.widget.ConstraintLayout  
    android:layout_width="match_parent"  
    android:layout_height="match_parent">
```

```
<TextView  
    ...
```

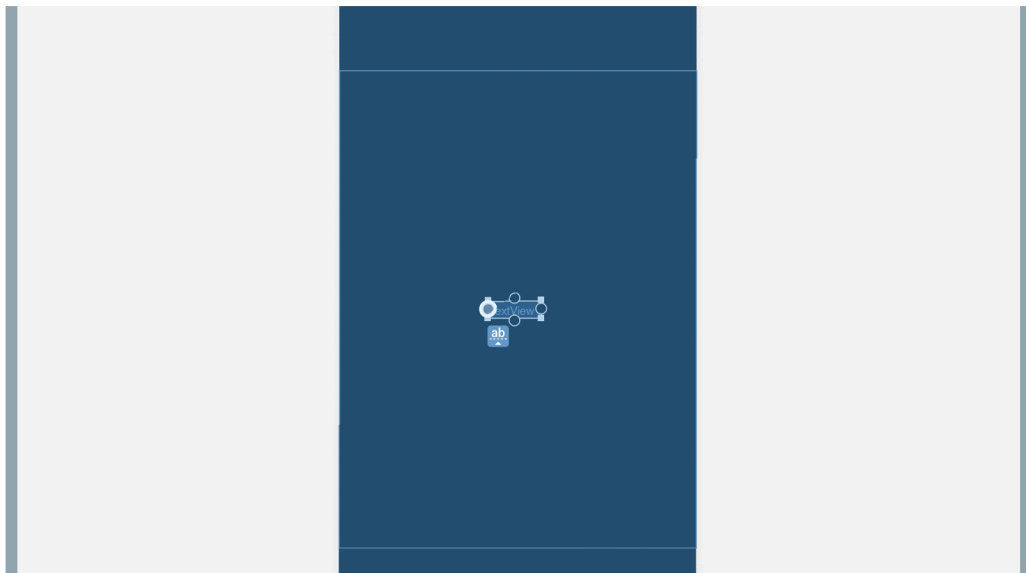
```
    app:layout_constraintBottom_toBottomOf="parent"  
    app:layout_constraintEnd_toEndOf="parent"  
    app:layout_constraintStart_toStartOf="parent"  
    app:layout_constraintTop_toTopOf="parent" />
```

```
</androidx.constraintlayout.widget.ConstraintLayout>
```



# Layout Editor in Android Studio

You can click and drag to add constraints to a View.



# Constraint Widget in Layout Editor



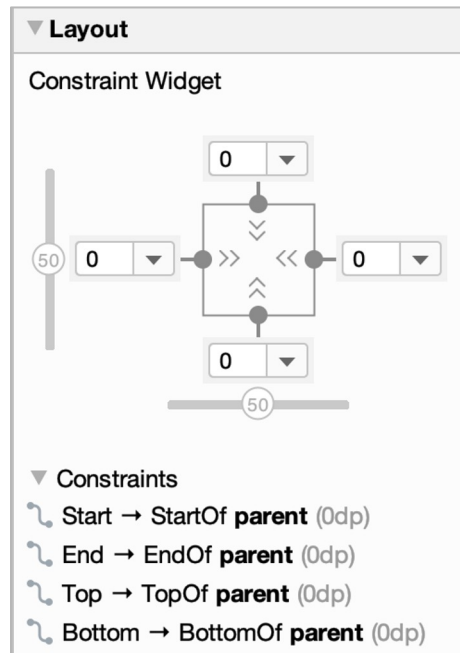
Fixed



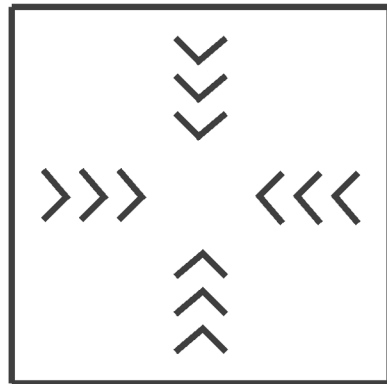
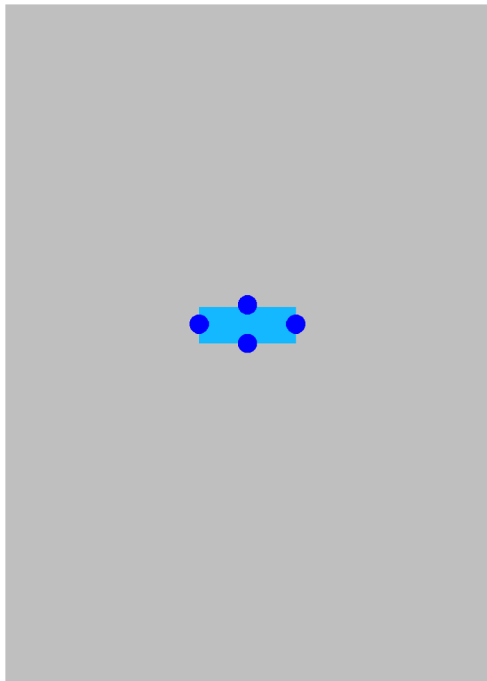
Wrap content



Match constraints



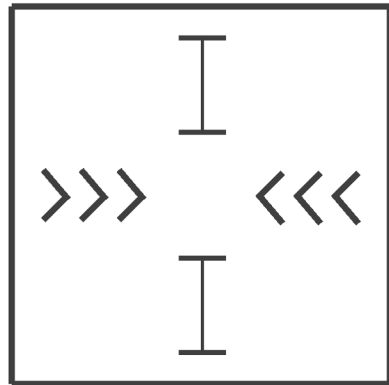
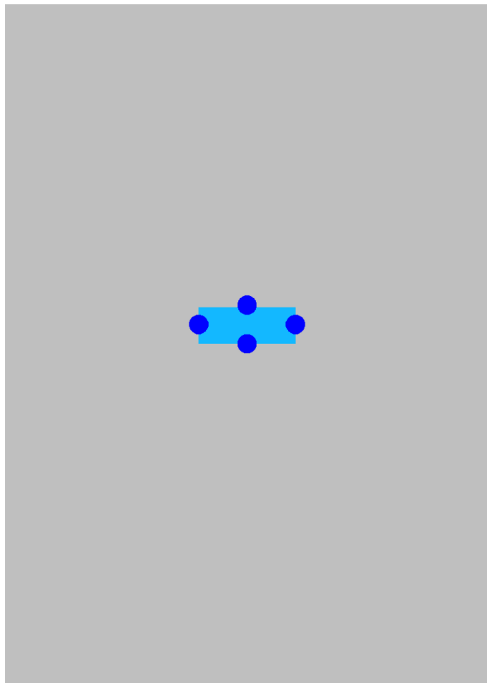
# Wrap content for width and height



`layout_width`    `wrap_content`

`layout_height`    `wrap_content`

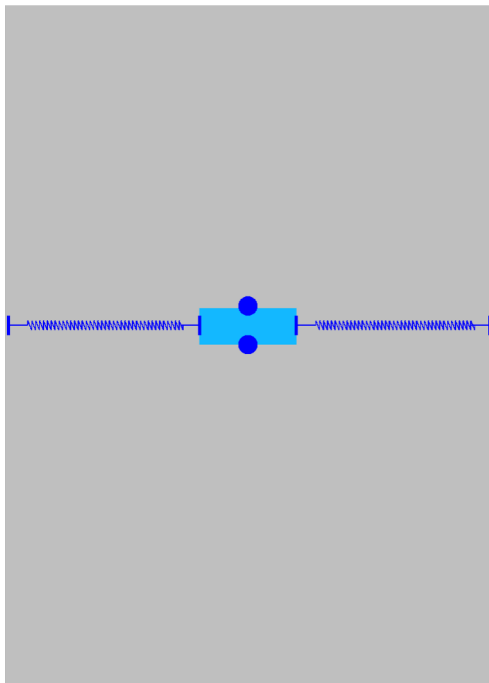
# Wrap content for width, fixed height



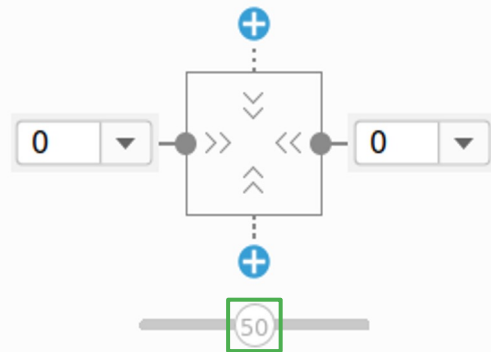
`layout_width`    `wrap_content`

`layout_height`    `48dp`

# Center a view horizontally



Constraint Widget

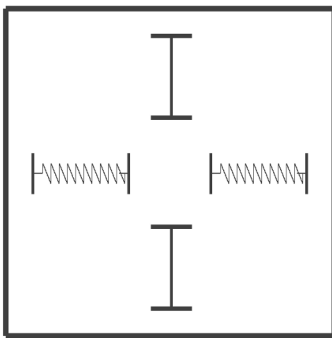
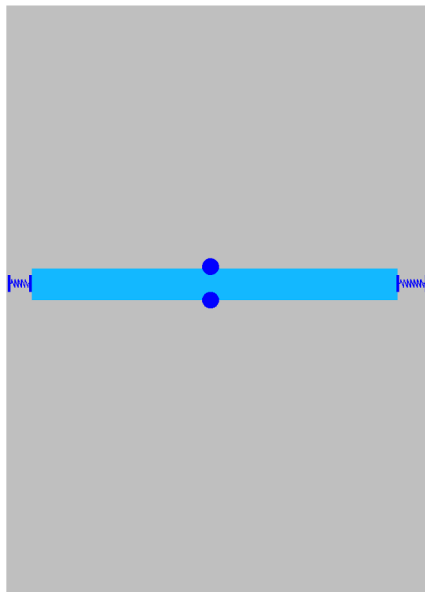


▼ Constraints

- Left → LeftOf **parent** (0dp)
- Right → RightOf **parent** (0dp)

# Use match\_constraint

Can't use `match_parent` on a child view, use `match_constraint` instead



`layout_width`     `0dp(match_constraint)`

`layout_height`   `48dp`

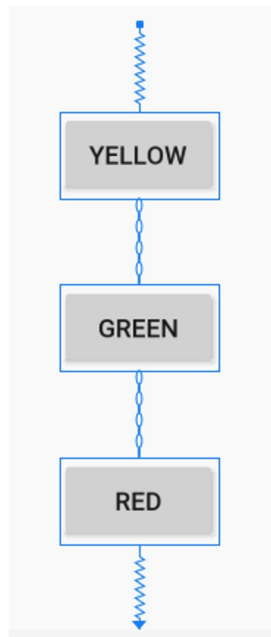
# Chains

- Let you position views in relation to each other
- Can be linked horizontally or vertically
- Provide much of LinearLayout functionality



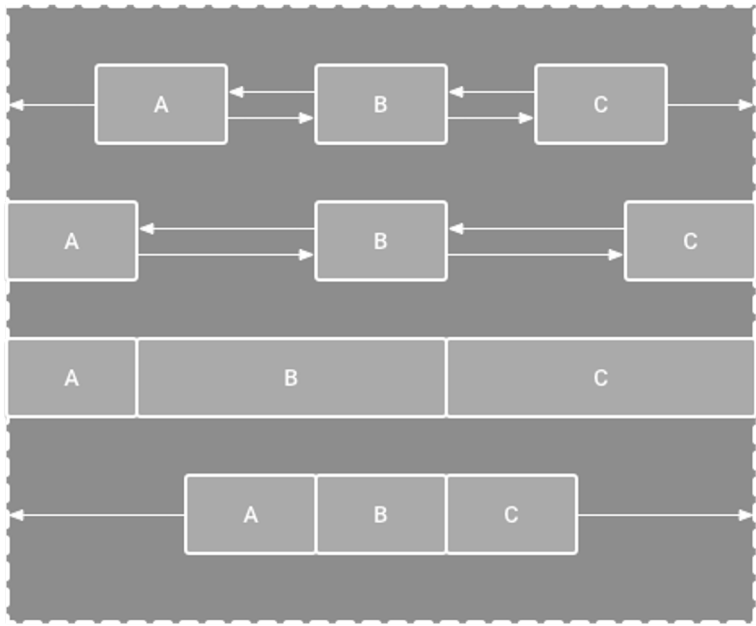
# Create a Chain in Layout Editor

1. Select the objects you want to be in the chain.
2. Right-click and select **Chains**.
3. Create a horizontal or vertical chain.



# Chain styles

Adjust space between views with these different chain styles.



Spread Chain

Spread Inside Chain

Weighted Chain

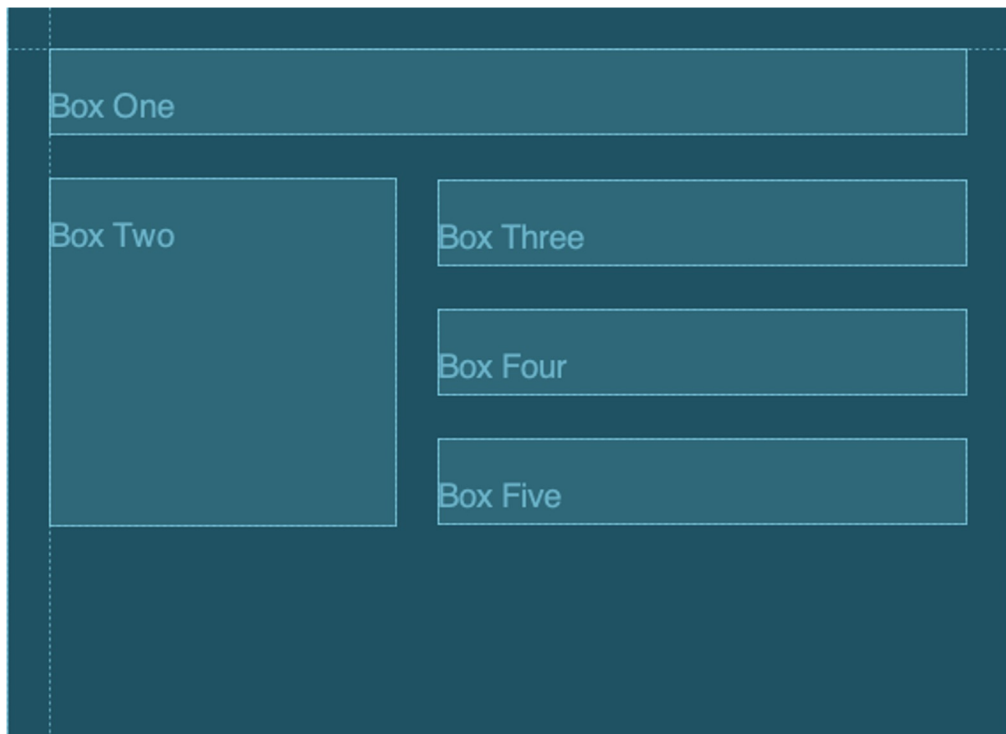
Packed Chain

# Additional topics for ConstraintLayout

# Guidelines

- Let you position multiple views relative to a single guide
- Can be vertical or horizontal
- Allow for greater collaboration with design/UX teams
- Aren't drawn on the device

# Guidelines in Android Studio



# Example Guideline

```
<ConstraintLayout>
```

```
    <androidx.constraintlayout.widget.Guideline
```

```
        android:id="@+id/start_guideline"
```

```
        android:layout_width="wrap_content"
```

```
        android:layout_height="wrap_content"
```

```
        android:orientation="vertical"
```

```
        app:layout_constraintGuide_begin="16dp" />
```

```
    <TextView ...
```

```
        app:layout_constraintStart_toEndOf="@id/start_guideline" />
```

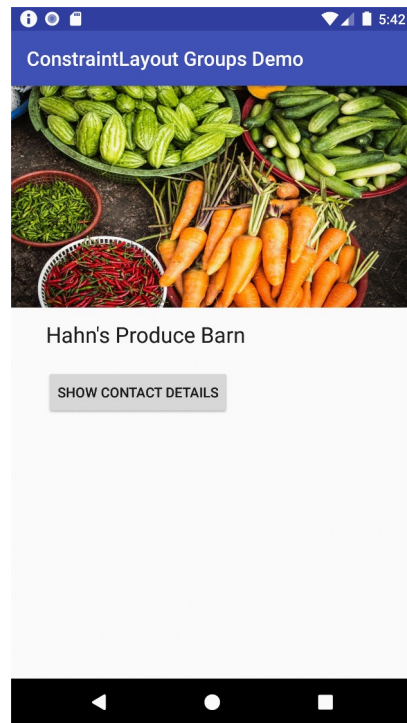
```
</ConstraintLayout>
```

# Creating Guidelines

- `layout_constraintGuide_begin`
- `layout_constraintGuide_end`
- `layout_constraintGuide_percent`

# Groups

- Control the **visibility** of a set of widgets
- Group visibility can be toggled in code





# Example group

```
<androidx.constraintlayout.widget.Group  
    android:id="@+id/group"  
    android:layout_width="wrap_content"  
    android:layout_height="wrap_content"  
    app:constraint_referenced_ids="locationLabel,locationDetails"/>
```

# Groups app code

```
override fun onClick(v: View?) {  
    if (group.visibility == View.GONE) {  
        group.visibility = View.VISIBLE  
        button.setText(R.string.hide_details)  
    } else {  
        group.visibility = View.GONE  
        button.setText(R.string.show_details)  
    }  
}
```

# Data binding

# Current approach: findViewById()

Traverses the `View` hierarchy each time

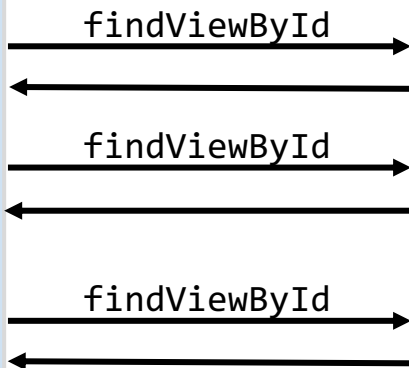
MainActivity.kt

```
val name = findViewById(...)
val age = findViewById(...)
val loc = findViewById(...)

name.text = ...
age.text = ...
loc.text = ...
```

activity\_main.xml

```
<ConstraintLayout ... >
  <TextView
    android:id="@+id/name"/>
  <TextView
    android:id="@+id/age"/>
  <TextView
    android:id="@+id/loc"/>
</ConstraintLayout>
```



# Use data binding instead

Bind UI components in your layouts to data sources in your app.

MainActivity.kt

```
Val binding:ActivityMainBinding
```

```
binding.name.text = ...
```

```
binding.age.text = ...
```

```
binding.loc.text = ...
```

initialize binding

activity\_main.xml

```
<layout>
  <ConstraintLayout ... >
    <TextView
      android:id="@+id/name"/>
    <TextView
      android:id="@+id/age"/>
    <TextView
      android:id="@+id/loc"/>
  </ConstraintLayout>
</layout>
```

# Modify build.gradle file

```
android {  
    ...  
    buildFeatures {  
        dataBinding true  
    }  
}
```

# Add layout tag

**<layout>**

```
<androidx.constraintlayout.widget.ConstraintLayout>  
    <TextView ... android:id="@+id/username" />  
    <EditText ... android:id="@+id/password" />  
</androidx.constraintlayout.widget.ConstraintLayout>
```

**</layout>**

# Layout inflation with data binding

Replace this

```
setContentView(R.layout.activity_main)
```

with this

```
val binding: ActivityMainBinding = DataBindingUtil.setContentView(  
    this, R.layout.activity_main)
```

```
binding.username = "Melissa"
```



# Data binding layout variables

```
<layout>
    <data>
        <variable name="name" type="String"/>
    </data>
    <androidx.constraintlayout.widget.ConstraintLayout>
        <TextView
            android:id="@+id/textView"
            android:text="@{name}" />
        </androidx.constraintlayout.widget.ConstraintLayout>
</layout>
```

In MainActivity.kt:

```
binding.name = "John"
```

# Data binding layout expressions

```
<layout>
  <data>
    <variable name="name" type="String"/>
  </data>

  <androidx.constraintlayout.widget.ConstraintLayout>
    <TextView
      android:id="@+id/textView"
      android:text="@{name.toUpperCase()}" />
    </androidx.constraintlayout.widget.ConstraintLayout>
</layout>
```

# Displaying lists with RecyclerView



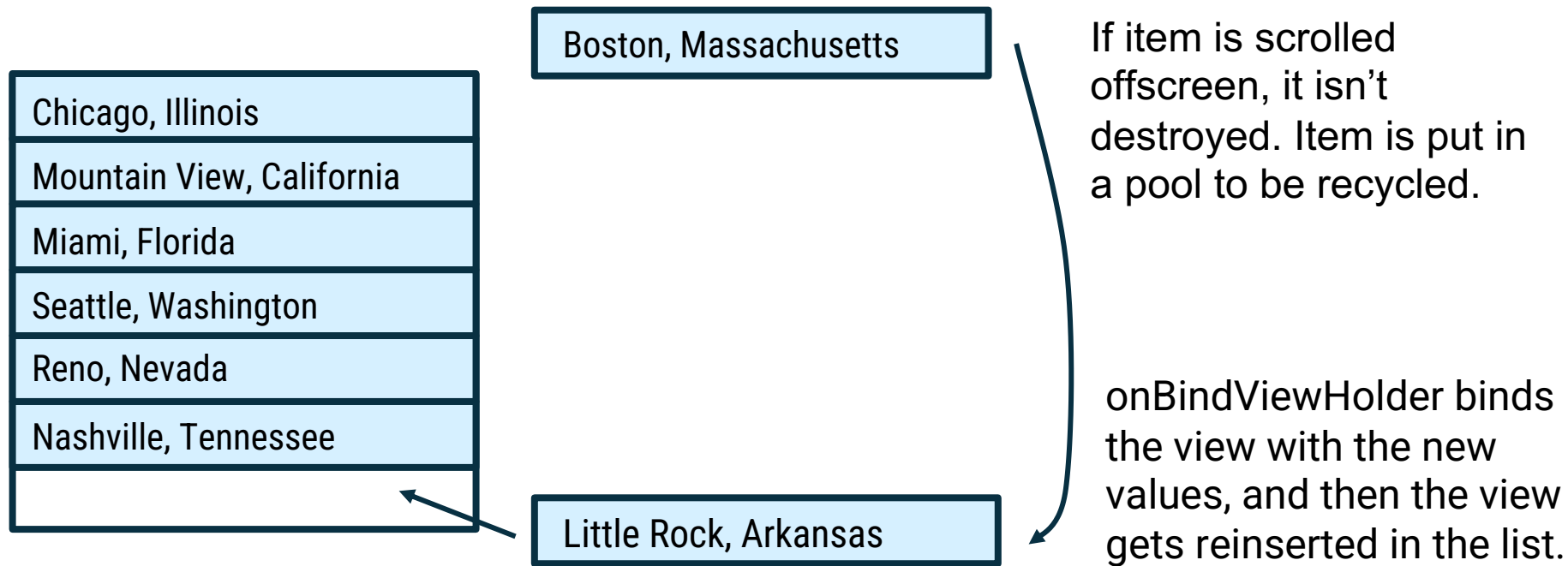
# RecyclerView

- Widget for displaying lists of data
- "Recycles" (reuses) item views to make scrolling more performant
- Can specify a list item layout for each item in the dataset
- Supports animations and transitions

# RecyclerView.Adapter

- Supplies data and layouts that the RecyclerView displays
- A custom Adapter extends from `RecyclerView.Adapter` and overrides these three functions:
  - `getItemCount`
  - `onCreateViewHolder`
  - `onBindViewHolder`

# View recycling in RecyclerView



# Add RecyclerView to your layout

```
<androidx.recyclerview.widget.RecyclerView  
    android:id="@+id/rv"  
    android:scrollbars="vertical"  
    android:layout_width="match_parent"  
    android:layout_height="match_parent"/>
```

# Create a list item layout

res/layout/item\_view.xml

```
<FrameLayout
    android:layout_width="match_parent"
    android:layout_height="wrap_content">
    <TextView
        android:id="@+id/number"
        android:layout_width="match_parent"
        android:layout_height="wrap_content" />
</FrameLayout>
```



# Create a list adapter

```
class MyAdapter(val data: List<Int>) : RecyclerView.Adapter<MyAdapter.MyViewHolder>()
{
    class MyViewHolder(val row: View) : RecyclerView.ViewHolder(row) {
        val textView = row.findViewById<TextView>(R.id.number)
    }

    override fun onCreateViewHolder(parent: ViewGroup, viewType: Int): MyViewHolder {
        val layout = LayoutInflater.from(parent.context).inflate(R.layout.item_view,
            parent, false)
        return MyViewHolder(layout)
    }
    override fun onBindViewHolder(holder: MyViewHolder, position: Int) {
        holder.textView.text = data.get(position).toString()
    }
    override fun getItemCount(): Int = data.size
}
```



# Set the adapter on the RecyclerView

In MainActivity.kt:

```
override fun onCreate(savedInstanceState: Bundle?) {  
    super.onCreate(savedInstanceState)  
    setContentView(R.layout.activity_main)  
  
    val rv: RecyclerView = findViewById(R.id.rv)  
    rv.layoutManager = LinearLayoutManager(this)  
  
    rv.adapter = MyAdapter(IntRange(0, 100).toList())  
}
```

# Summary

# Summary

In Lesson 5, you learned how to:

- Specify lengths in dp for your layout
- Work with screen densities for different Android devices
- Render Views to the screen of your app
- Layout views within a ConstraintLayout using constraints
- Simplify getting View references from layout with data binding
- Display a list of text items using a RecyclerView and custom adapter

# Learn more

- [Pixel density on Android](#)
- [Spacing](#)
- [Device metrics](#)
- [Type scale](#)
- [Build a Responsive UI with ConstraintLayout](#)
- [Data Binding Library](#)
- [Create dynamic lists with RecyclerView](#)

# Pathway

Practice what you've learned by completing the pathway:

[Lesson 5: Layouts](#)

