Material Design, AsyncTask & RecyclerView

IN721: Mobile Application Development

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Today’s Content

- Material Design
- AsyncTask
- RecyclerView

Preparation

- Instead of creating a new app, copy the app from the last session & rename it to Practical02
- Open Practical02 in Android Studio
- In strings.xml, change the app name to Practcial02

Material Design

Material Design

- Developed by Google in 2014
- Design system
- Inspired by the physical world
- Applied to many Google mobile apps for Android, iOS & the web

Material Design - Components

- Cards, lists & sheets
- Navigation drawers & tabs
- Floating action button
- Text fields, chips & selection controls
- Snackbars, banners & dialogs
- Resource: Material Design

Material Design - Theming

- Color
- Typography
- Shape
- Resource: Components

Material Design - Elevation

- Three-dimensional space
- X, Y & Z axis
- Resource: Elevation

Material Design - Dependencies

- Open up the app module's build.gradle file
- Add the following MDC Android support library to the dependencies block
- Click Sync Now in the top right-hand corner

```
api 'com.google.android.material:material:1.3.0-alpha01'
```

Material Design - Dependencies

- If a dependency is highlighted orange (new version available), update it
- The dependency block should look similar to the following:

```
dependencies {
    implementation fileTree(dir: "libs", include: ["*.jar"])
    implementation "org.jetbrains.kotlin:kotlin-stdlib:$kotlin_version"
    implementation 'androidx.core:core-ktx:1.3.0'
    implementation 'androidx.appcompat:appcompat:1.1.0'
    implementation 'androidx.constraintlayout:constraintlayout:1.1.3'
    testImplementation 'junit:junit:4.12'
    androidTestImplementation 'androidx.test.ext:junit:1.1.1'
    androidTestImplementation 'androidx.test.espresso:espresso-core:3.2.0'
    api 'com.google.android.material:material:1.3.0-alpha01'
}
```

styles.xml

- Go to styles.xml in res > values
- You should only have one style with the name attribute AppTheme
- In the AppTheme's parent attribute, change it to the following:

```
<style name="AppTheme" parent="Theme.MaterialComponents.Light.DarkActionBar">
    <item name="colorPrimary">@color/colorPrimary</item>
    <item name="colorPrimaryDark">@color/colorPrimaryDark</item>
    <item name="colorAccent">@color/colorAccent</item>
</style>
```

activity_main.xml

- Replace each widget except for the EditText widgets with its Material Design equivalent, for example, TextView should be replaced with com.google.android.material.textview.MaterialTextView
- There is no Material Design element for a Spinner

```
<com.google.android.material.textview.MaterialTextView
    android:id="@+id/output_text"
    android:layout_width="0dp"
    android:layout_height="wrap_content"
    android:layout_marginLeft="16dp"
    android:layout_marginTop="16dp"
    android:layout_marginRight="16dp"
    android:gravity="center"
    android:text="Hello World!"
    android:textSize="24sp"
    app:layout_constraintLeft_toLeftOf="parent"
    app:layout_constraintRight_toRightOf="parent"
    app:layout_constraintTop_toTopOf="parent" />
```

activity_main.xml

- EditText widgets are slightly more complicated
- TextInputLayout
- TextInputEditText

activity_main.xml

- TextInputLayout

```
<com.google.android.material.textfield.TextInputLayout
    android:id="@+id/email_text_input"
    android:layout_width="0dp"
    android:layout_height="wrap_content"
    android:layout_marginStart="16dp"
    android:layout_marginLeft="16dp"
    android:layout_marginTop="16dp"
    android:layout_marginEnd="16dp"
    android:layout_marginRight="16dp"
    android:hint="Email Address"
    app:errorEnabled="true"
    app:layout_constraintEnd_toEndOf="parent"
    app:layout_constraintStart_toStartOf="parent"
    app:layout_constraintTop_toBottomOf="@+id/months_spinner">

    <!-- TextInputEditText goes here -->

</com.google.android.material.textfield.TextInputLayout>
```

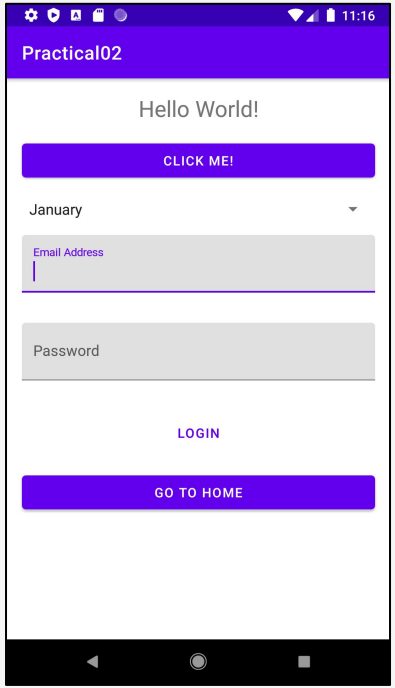
activity_main.xml

- TextInputEditText

```
<com.google.android.material.textfield.TextInputEditText
      android:id="@+id/email_edit_text"
      android:layout_width="match_parent"
      android:layout_height="wrap_content"
      android:inputType="textEmailAddress" />
```

Emulator

- Run app
- You will notice the styles of the default widgets have changed
- Experiment with the colours. The default colours are not visually appealing
- EditText widgets look odd. Lets style even more



styles.xml

- Add the following style to styles.xml

```
<style name="Widget.TextInputLayout" parent="Widget.MaterialComponents.TextInputLayout.OutlinedBox">
    <item name="boxStrokeColor">@color/colorPrimary</item>
</style>
```

Emulator

- Run app
- Is there is any visible change?
- Why?

activity_main.xml

- Add style attribute to TextInputLayout

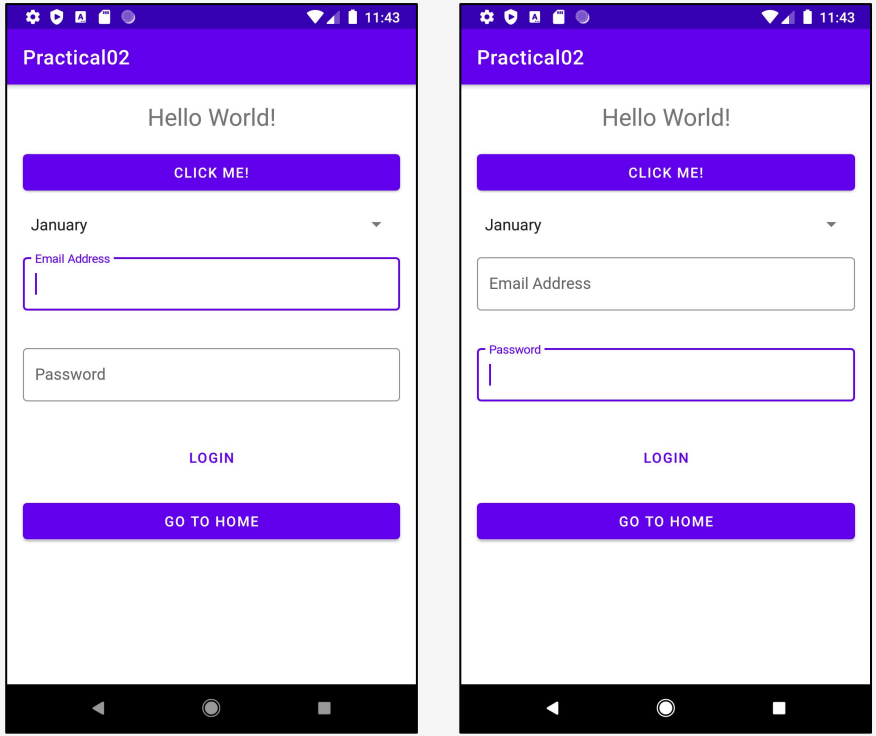
```
<com.google.android.material.textfield.TextInputLayout
    android:id="@+id/email_text_input"
    style="@style/Widget.TextInputLayout"
    android:layout_width="0dp"
    android:layout_height="wrap_content"
    android:layout_marginStart="16dp"
    android:layout_marginLeft="16dp"
    android:layout_marginTop="16dp"
    android:layout_marginEnd="16dp"
    android:layout_marginRight="16dp"
    android:hint="Email Address"
    app:errorEnabled="true"
    app:layout_constraintEnd_toEndOf="parent"
    app:layout_constraintStart_toStartOf="parent"
    app:layout_constraintTop_toBottomOf="@+id/months_spinner">

    <!-- TextInputEditText goes here -->

</com.google.android.material.textfield.TextInputLayout>
```

Emulator

- Run app
- EditText widgets look better
- No more grey background



Preparation

- Open Practical03 app in Android Studio
- View the res directory, in particular, the layout directory & strings.xml
- View AndroidManifest.xml. What is different about this file?
- Create a data class called Album
- Create two classes called RawDataAsyncTask & LastFmAsyncTask which extends AsyncTask
- Create a class called LastFmRecyclerViewAdapter which extends RecyclerView.Adapter
- Create a classed called LastFmViewHolder which extends RecyclerView.ViewHolder
- Create one enum class called DownloadStatus
- Create two interfaces classes called IDataDownloadComplete & IDataDownloadAvailable

Permissions

- What permission have we used?
- If the permission is not declared, the java.lang.SecurityException is raised
- Protect privacy of an Android user
- Apps must request permission to sensitive user data
- The system may grant the permission automatically or might prompt the user to approve the request
- We will look more into in a couple of weeks
- Resource: Permissions

Picasso

- Android Picasso
- An image loading/processing library developed & maintained by Square Inc.
- Simplifies the process of displaying images from external locations
- Most third-party services need to be referenced in the build.gradle (module)
- Resource: Picasso

```
implementation 'com.squareup.picasso:picasso:2.5.2'
```

Album.kt

- Data class
- Two properties
  - Name
  - Image
- Resource: Data Classes

```
data class Album(
    var name: String?,
    var image: String?
)
```

DownloadStatus.kt

- Enum class
- Two enums
  - If the response code is 200, the status is OK. If not, the status is NONE
  - You should be checking for different exceptions. Something you all should be thinking about
- Resource: Enum Classes

```
enum class DownloadStatus {
    NONE,
    OK
}
```

IDataDownloadComplete.kt

- onDownloadComplete
  - Return a JSON response from the API
  - Reference to DownloadStatus.kt

```
interface IDataDownloadComplete {
    fun onDownloadComplete(data: String, status: DownloadStatus)
}
```

IDataDownloadAvailable.kt

- onDataAvailable
  - Return an ArrayList of Album objects
- onError

```
interface IDataDownloadAvailable {
    fun onDataAvailable(data: ArrayList<Album>)
    fun onError(e: Exception)
}
```

AsyncTask

Last.fm API

- Last.fm API
- What happens when you click on the resource link below?
- I have given you an API key...is this secure?
- Resource: Last.fm API

AsyncTask

- Defined by a computation that runs on a background thread
- Whose result is published on the UI thread
- Should ideally be used for short operations, for example, fetching data from an API
- When an async task is executed, the task goes through four steps:
  - onPreExecute()
  - doInBackground()
  - onProgressUpdate()
  - onPostExecute()
- Today we will look at doInBackground() & onPostExecute()
- In week four, we will look at the other two
- Resource: AsyncTask

RawDataAsyncTask.kt

- Extends AsyncTask
- Reference to IDataDowloadComplete.kt
- Three generic types used by an async task
  - Params - parameters sent to the task upon execution
  - Progress - progress units published during the background computation
  - Result - result of the background computation

```
class RawDataAsyncTask(private val listener: IDataDownloadComplete) :
    AsyncTask<String, Void, String>() {

    // override fun downloadData

    // override fun doInBackground

    // override fun onPostExecute
}
```

downloadData

- Private function
- Returns the entire contents of the URL as a String using UTF-8
- Resource: readText

```
private fun downloadData(urlPath: String): String {
    return URL(urlPath).readText()
}
```

doInBackground

- doInBackground
  - Invoked on the background thread immediately after onPreExecute() finishes executing
  - Params of the async task are passed to this step
  - The result must be return by this step & be passed back to the last step

```
override fun doInBackground(vararg url: String): String {
    var data = ""
    try {
        downloadStatus = OK
        data = downloadData(url[0])
    } catch (e: Exception) {
        e.printStackTrace()
    }
    return data
}
```

onPostExecute

- Invoked on the UI thread after the background computation finishes
- The result is passed to this step as a parameter
- result - data returned by the last step
- downloadStatus - OK

```
override fun onPostExecute(result: String) {
    listener.onDownloadComplete(result, downloadStatus)
}
```

LastFmAsyncTask.kt

- Extends AsyncTask
- Reference to IDataDowloadAvailable.kt

```
class LastFmAsyncTask(private val listener: IDataDownloadAvailable) :
    AsyncTask<String, Void, ArrayList<Album>>() {

    // override fun doInBackground

    // override fun onPostExecute
}
```

doInBackground

- ArrayList of Album objects
- Get data from the JSON response
  - Copy & paste the contents of **try-catch-async-task.txt**
- Return ArrayList of Album
- Resource: JSON

```
override fun doInBackground(vararg url: String): ArrayList<Album> {
    val albums = ArrayList<Album>()
    // try/catch - get data from the JSON response
    return albums
}
```

onPostExecute

- result - ArrayList of Albums returned by the last step

```
override fun onPostExecute(result: ArrayList<Album>) {
    listener.onDataAvailable(result)
}
```

RecyclerView

LastFmViewHolder.kt

- Describes an item view & metadata about its place within the RecyclerView
- Extends RecyclerView.ViewHolder
- Add fields for caching potentially expensive View.findViewById results
- ViewHolder will hold a TextView & ImageView. Refer to album_item.xml
- Resource: RecyclerView.ViewHolder

```
class LastFmViewHolder(view: View) : RecyclerView.ViewHolder(view) {
    var albumNameText: TextView = view.findViewById(R.id.album_name_text)
    var albumImageView: ImageView = view.findViewById(R.id.album_image_view)
}
```

LastFmRecyclerViewAdapter.kt

- Extends RecyclerView.Adapter
- Resource: RecyclerView

```
class LastFmRecyclerViewAdapter(private var albums: ArrayList<Album>) :
    RecyclerView.Adapter<LastFmViewHolder>() {

    // fun loadNewData

    // override fun getItemCount

    // override fun onCreateViewHolder

    // override fun onBindViewHolder
}
```

loadNewData

- Notify any registered observers that the data has changed
- Two classes of data change events
  - Item changes
  - Structural changes
- Which OO design pattern is being used?
- Resource: notifyDataSetChanged

```
fun loadNewData(newAlbums: ArrayList<Album>) {
    albums = newAlbums
    notifyDataSetChanged()
}
```

getItemCount

- If the ArrayList of Album objects, return the total number of items held by the adapter
- Resource: getItemCount

```
override fun getItemCount(): Int {
    return if (albums.isNotEmpty()) albums.size else 0
}
```

onCreateViewHolder

- Called when the RecyclerView needs a new RecyclerView.ViewHolder of the given type to represent an item
- Inflating album_item.xml
- Resource: onCreateViewHolder

```
override fun onCreateViewHolder(parent: ViewGroup, viewType: Int): LastFmViewHolder {
    val view: View =
        LayoutInflater.from(parent.context).inflate(R.layout.album_item, parent, false)
    return LastFmViewHolder(view)
}
```

onBindViewHolder

- Called by the RecyclerView to display the data at the specific position
- ic_album_black_24.xml has been provided for you
- What is `viewHolder.albumNameText.text` highlighted orange?
  - Resource: itemView
- Resource: onBindViewHolder

```
override fun onBindViewHolder(viewHolder: LastFmViewHolder, position: Int) {
    val album: Album = albums[position]

    viewHolder.albumNameText.text = “Name: ” + album.name
    Picasso.with(viewHolder.albumImageView.context)
        .load(album.image)
        .placeholder(R.drawable.ic_album_black_24)
        .error(R.drawable.ic_album_black_24)
        .into(viewHolder.albumImageView)
}
```

MainActivity.kt

- Extends AppCompatActivity
- Implement IDataDownloadAvailable.kt & IDataDownloadComplete.kt

```
class MainActivity : AppCompatActivity(), IDataDownloadComplete,
    IDataDownloadAvailable {

    private lateinit var imageRecyclerView: RecyclerView
    private lateinit var rawDataAsyncTask: RawDataAsyncTask
    private lateinit var lastFmRecyclerViewAdapter: LastFmRecyclerViewAdapter

    // private fun buildUri

    // override fun onCreate

    // override fun onDowloadComplete

    // override fun onDataAvailable

    // override fun onError
}
```

buildURI

- Constructing a complex object, i.e. URI
- Which OO design pattern is being used?
- Resource: URI

```
private fun buildUri(
    baseURL: String, method: String, artist: String,
    apiKey: String, format: String
): String {
    return Uri.parse(baseURL)
        .buildUpon()
        .appendQueryParameter("method", method)
        .appendQueryParameter("artist", artist)
        .appendQueryParameter("api_key", apiKey)
        .appendQueryParameter("format", format)
        .build().toString()
}
```

onCreate

```
override fun onCreate(savedInstanceState: Bundle?) {
    super.onCreate(savedInstanceState)
    setContentView(R.layout.activity_main)

    lastFmRecyclerViewAdapter = LastFmRecyclerViewAdapter(ArrayList())
    imageRecyclerView = findViewById(R.id.album_recycler)
    imageRecyclerView.layoutManager = LinearLayoutManager(this@MainActivity)
    imageRecyclerView.adapter = lastFmRecyclerViewAdapter

    val url: String = buildUri(
        getString(R.string.base_url), getString(R.string.method),
        "cher", getString(R.string.api_key), getString(R.string.format)
    )
    rawDataAsyncTask = RawDataAsyncTask(this)
    rawDataAsyncTask.execute(url)
}
```

onDownloadComplete

- Check if the status is OK, execute the AsyncTask

```
override fun onDownloadComplete(data: String, status: DownloadStatus) {
    if (status == OK) {
        val lastFmAsyncTask = LastFmAsyncTask(this@MainActivity)
        lastFmAsyncTask.execute(data)
    }
}
```

onDataAvailable

- Load the available data into the RecylerView

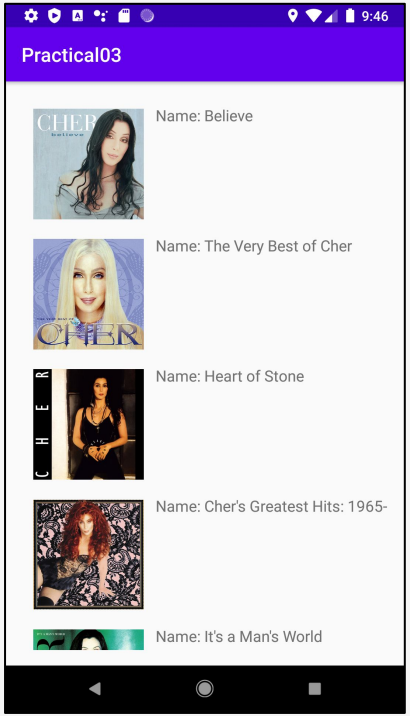
```
override fun onDataAvailable(data: ArrayList<Album>) {
    Log.d(getString(R.string.TAG), getString(R.string.on_data_available, data))
    lastFmRecyclerViewAdapter.loadNewData(data)
}
```

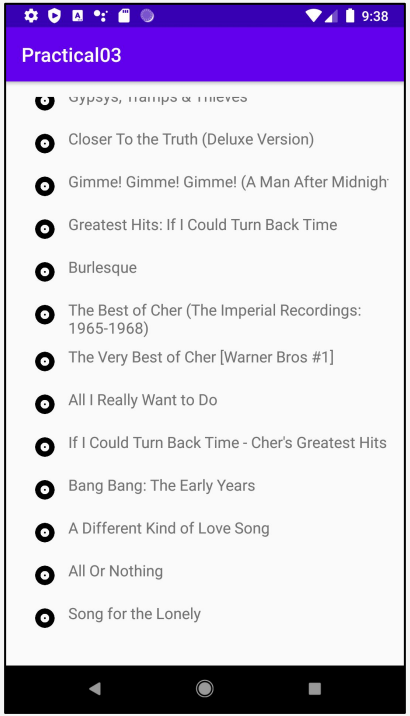
onError

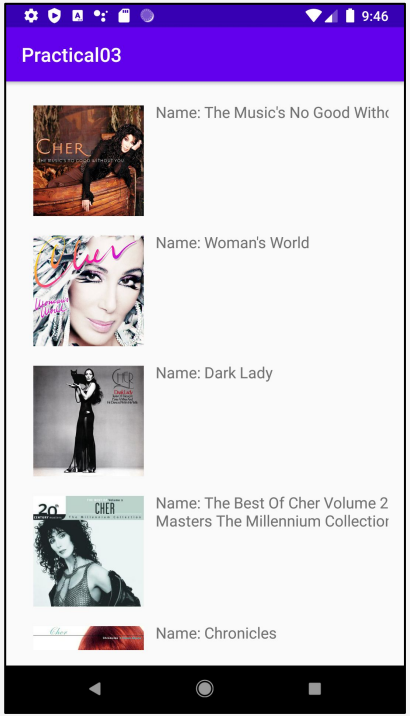
- Log any errors that may occur
- Resource: Logcat

```
override fun onError(e: Exception) {
    Log.d(getString(R.string.TAG), getString(R.string.on_error, e.message))
}
```

Emulator


9:46
Practical03
Name: Believe
Name: The Very Best of Cher
Name: Heart of Stone
Name: Cher's Greatest Hits: 1965-
Name: It's a Man's World

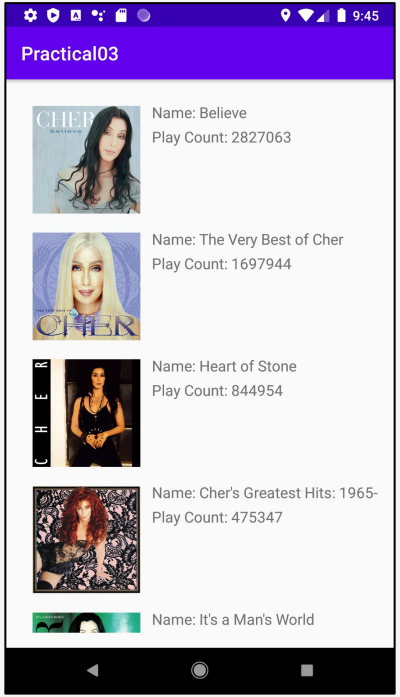

9:38
Practical03
Closer To the Truth (Deluxe Version)
Gimme! Gimme! Gimme! (A Man After Midnigh
Greatest Hits: If I Could Turn Back Time
Burlesque
The Best of Cher (The Imperial Recordings: 1965-1968)
The Very Best of Cher [Warner Bros #1]
All I Really Want to Do
If I Could Turn Back Time - Cher's Greatest Hits
Bang Bang: The Early Years
A Different Kind of Love Song
All Or Nothing
Song for the Lonely


9:46
Practical03
Name: The Music's No Good Withc
Name: Woman's World
Name: Dark Lady
Name: The Best Of Cher Volume 2
Masters The Millennium Collectior
Name: Chronicles

Practical

- Please use the current app
- Independent tasks:
  - Implement the code as specified in the previous lecture slides
  - In album_item.xml, add a TextView. The TextView will display the album's play count
  - In Album.kt, add a property for play count
  - In LastFmAsyncTask.kt, get the play count data from the JSON response
  - In LastFmViewHolder.kt, add the View from album_item.xml
  - In LastFmRecyclerViewAdapter.kt, bind the appropriate data to the View in LastFmViewHolder.kt
  - Make sure to use Material Design
  - Once you have completed the practical, create a branch named 02-submission, push the app to the branch, make a pull request & set Grayson-Orr as the reviewer
  - If you do not set Grayson-Orr as a reviewer, I will not mark off your practical
  - DO NOT MERGE YOUR OWN PULL REQUEST!

Expected Output



Formative Assessment

- Please write your answers to the following questions in your app:
  - What are the three generic types used by an async task?
  - What are the four steps that an async task goes through when executed?