

COS30017 Software Development for Mobile Devices

Formative Assignment 1

Task 1

Sub-task 1.1

Builder Design Pattern

```
import retrofit2.Retrofit;
import retrofit2.converter.gson.GsonConverterFactory;

public class RetrofitClient {

    private static Retrofit retrofit = null;

    public static Retrofit getClient(String baseUrl) {
        if (retrofit == null) {
            retrofit = new Retrofit.Builder()
                .baseUrl(baseUrl)
                .addConverterFactory(GsonConverterFactory.create())
                .build();
        }
        return retrofit;
    }
}
```

The code snippet above outlined in the circle demonstrates the Builder design pattern. The Builder design pattern is an alternative way to instantiate complex objects by separating the construction into different parts as seen with the various setter methods used in the construction of the Retrofit object. A Retrofit object is used to execute network request in an Android application.

In the code snippet above, the Retrofit constructor calls the Builder method inside the Retrofit class. It then further calls the setter methods for the desired property it wants to add to the Retrofit object. Finally, it instantiates the object with the build method.

The Builder method contains setters for all the properties of the Retrofit object. All one needs is to call the setter method for the desired property. This allows for the creation of constructors with flexible parameters as well providing highly readable code as unused parameters are not called.

Adaptor Design Pattern

```
ArrayAdapter adapter = new ArrayAdapter<String>(this,  
    R.layout.activity_listview, mobileArray);
```

```
ListView listView = (ListView) findViewById(R.id.mobile_list);  
listView.setAdapter(adapter);
```

The code snippet above demonstrates the use of the Adaptor design pattern. The Adaptor design pattern works as a bridge between two incompatible interfaces.

The code snippet uses the ArrayAdapter to bridge the different interfaces between ListView layout and the array of data which will be displayed in the ListView layout. The ArrayAdapter object is defined as a string data type, it receives the current context, the ListView layout it intends to adapt, and the array of string itself as parameters. The setAdapter method is called by the main ListView to display the now formatted ListView containing the data in the string array.

Sub-task 1.2

A Singleton design pattern only allows for the instantiation of a class of object once for the entire duration the application is running. It is typically used in the instantiation of a class that manages the application, if there is more than one of that particular class, issues will arise in terms incorrect application behavior, resource overuse and incorrect display of results.

The below code snippet demonstrates how a Singleton class is used in Android.

```
import retrofit2.Retrofit;  
import retrofit2.converter.gson.GsonConverterFactory;  
  
public class RetrofitClient {  
  
    private static Retrofit retrofit = null;  
  
    public static Retrofit getClient(String baseUrl) {  
        if (retrofit==null) {  
            retrofit = new Retrofit.Builder()  
                .baseUrl(baseUrl)  
                .addConverterFactory(GsonConverterFactory.create())  
                .build();  
        }  
        return retrofit;  
    }  
}
```

The above code snippet describes the use of Singleton design pattern in the creation of a Retrofit object which is used to execute network request in an Android application. Firstly, a static Retrofit variable is created to hold a Retrofit object instance and is initially set to null. In normal Singleton classes, the constructor method is made private to ensure the class can only instantiate itself, however, this is not demonstrated in the code snippet above. Moving on, the getClient() method checks if the static variable is null, if true, it will instantiate a new Retrofit object which will returned to the caller.

Task 2

Sub-task 2.1

XML

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

    <TextView
        android:id="@+id/commonsTextView"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:layout_marginTop="10dp"
        android:text="@string/commons"
        android:textColor="@color/commons"
        android:textStyle="bold"
        android:textAlignment="center"/>

    <TextView
        android:id="@+id/cuisineTextView"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:text="@string/cuisine"
        android:textColor="@color/cuisine"
        android:textAlignment="center"
        android:layout_marginBottom="4dp"/>

    <ImageView
        android:id="@+id/commonImageView"
        android:layout_width="match_parent"
        android:layout_height="183dp"
        android:contentDescription="@string/commonsImg"
        android:scaleType="fitXY"
        app:srcCompat="@drawable/commons" />

    <LinearLayout
        android:id="@+id/innerLinearLayout"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:orientation="vertical"
        android:layout_marginTop="4dp">

        <TextView
            android:id="@+id/addressTitle"
            android:layout_width="match_parent"
```

```

        android:layout_height="wrap_content"
        android:text="@string/addressTitle"
        android:textColor="@color/title"
        android:textStyle="bold"
        android:layout_marginStart="10dp"
        android:textSize="15sp"/>
<RelativeLayout
    android:id="@+id/innerRelativeLayout"
    android:layout_width="match_parent"
    android:layout_height="wrap_content">

    <ImageView
        android:contentDescription="@string/location_icon"
        android:id="@+id/iconImageView"
        android:layout_width="12dp"
        android:layout_height="12dp"
        app:srcCompat="@drawable/location"
        android:layout_marginStart="10dp"
        android:layout_marginTop="4dp" />

    <TextView
        android:id="@+id/address"
        android:layout_width="328dp"
        android:layout_height="wrap_content"
        android:text="@string/address"
        android:textColor="#831B18"
        android:textSize="10sp"
        android:layout_toEndOf="@id/iconImageView"
        android:layout_marginStart="12dp"
        android:layout_marginTop="1dp"/>

</RelativeLayout>
<TextView
    android:id="@+id/openingTitle"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:text="@string/openingTitle"
    android:textStyle="bold"
    android:textColor="@color/title"
    android:layout_marginStart="10dp"
    android:textSize="15sp"/>
<RelativeLayout
    android:id="@+id/innerRelativeLayout2"
    android:layout_width="match_parent"
    android:layout_height="wrap_content">

    <ImageView
        android:contentDescription="@string/clock_icon"
        android:id="@+id/clockImageView"
        android:layout_width="12dp"

```

```

        android:layout_height="12dp"
        app:srcCompat="@drawable/clock"
        android:layout_marginStart="10dp"
        android:layout_marginTop="4dp" />
<TextView
    android:id="@+id/opening"
    android:layout_width="328dp"
    android:layout_height="wrap_content"
    android:text="@string/opening"
    android:textColor="#831B18"
    android:textSize="10sp"
    android:layout_toEndOf="@id/clockImageView"
    android:layout_marginStart="12dp"
    android:layout_marginTop="1dp"/>
</RelativeLayout>
</LinearLayout>

<TableRow
    android:id="@+id/hr"
    android:layout_width="match_parent"
    android:layout_height="1dp"
    android:background="@color/hr"
    android:layout_marginTop="5dp"/>
<TextView
    android:id="@+id/reviewTextView"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:text="@string/review"
    android:textStyle="bold"
    android:textColor="@color/title"
    android:textSize="15sp"
    android:layout_marginStart="10dp"/>

<TableLayout
    android:id="@+id/tableLayout"
    android:layout_width="fill_parent"
    android:layout_height="match_parent">

    <TableRow
        android:id="@+id/row1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:orientation="horizontal">

        <RelativeLayout
            android:id="@+id/innerRelativeLayout3"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_column="1">

            <ImageView

```

```
    android:id="@+id/foodImageView"
    android:layout_width="15sp"
    android:layout_height="15sp"
    android:layout_marginStart="10dp"
    android:layout_marginTop="5dp"
    app:srcCompat="@drawable/food_icon" />
```

```
<TextView
    android:id="@+id/foodTextView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginStart="10dp"
    android:layout_marginTop="2dp"
    android:layout_toEndOf="@id/foodImageView"
    android:text="@string/food"
    android:textColor="@color/title"
    android:textSize="15sp"
    android:textStyle="bold" />
```

```
<ImageView
    android:id="@+id/rating1ImageView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_below="@id/foodTextView"
    android:layout_marginStart="35dp"
    app:srcCompat="@drawable/love3_icon" />
```

```
</RelativeLayout>
```

```
<RelativeLayout
    android:id="@+id/innerRelativeLayout4"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_column="2">
```

```
<ImageView
    android:contentDescription="@string/drink_icon"
    android:id="@+id/drinkImageView"
    android:layout_width="15sp"
    android:layout_height="15sp"
    android:layout_marginStart="20dp"
    android:layout_marginTop="5dp"
    app:srcCompat="@drawable/drinks_icon" />
```

```
<TextView
    android:id="@+id/drinkTextView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginStart="10dp"
    android:layout_marginTop="2dp"
    android:layout_toEndOf="@id/drinkImageView"
```

```
    android:text="@string/drink"
    android:textColor="@color/title"
    android:textSize="15sp"
    android:textStyle="bold" />
```

```
<ImageView
    android:id="@+id/rating2ImageView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_below="@id/drinkImageView"
    android:layout_marginStart="43dp"
    app:srcCompat="@drawable/love4_icon" />
</RelativeLayout>
</TableRow>
```

```
<TableRow
    android:id="@+id/row2"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:orientation="horizontal">
```

```
<RelativeLayout
    android:id="@+id/innerRelativeLayout5"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_column="1">
```

```
<ImageView
    android:id="@+id/serviceImageView"
    android:layout_width="15sp"
    android:layout_height="15sp"
    android:layout_marginStart="10dp"
    android:layout_marginTop="5dp"
    app:srcCompat="@drawable/service_icon" />
```

```
<TextView
    android:id="@+id/serviceTextView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginLeft="10dp"
    android:layout_marginTop="6dp"
    android:layout_toRightOf="@id/serviceImageView"
    android:text="@string/service"
    android:textColor="@color/title"
    android:textSize="15dp"
    android:textStyle="bold" />
```

```
<ImageView
    android:id="@+id/rating3ImageView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
```

```

        android:layout_below="@id/serviceTextView"
        android:layout_marginStart="35dp"
        app:srcCompat="@drawable/love5_icon" />
</RelativeLayout>

<RelativeLayout
    android:id="@+id/innerRelativeLayout6"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_column="2">

    <ImageView
        android:id="@+id/ambienceImageView"
        android:layout_width="15sp"
        android:layout_height="15sp"
        android:layout_marginStart="20dp"
        android:layout_marginTop="5dp"
        app:srcCompat="@drawable/ambience_icon" />

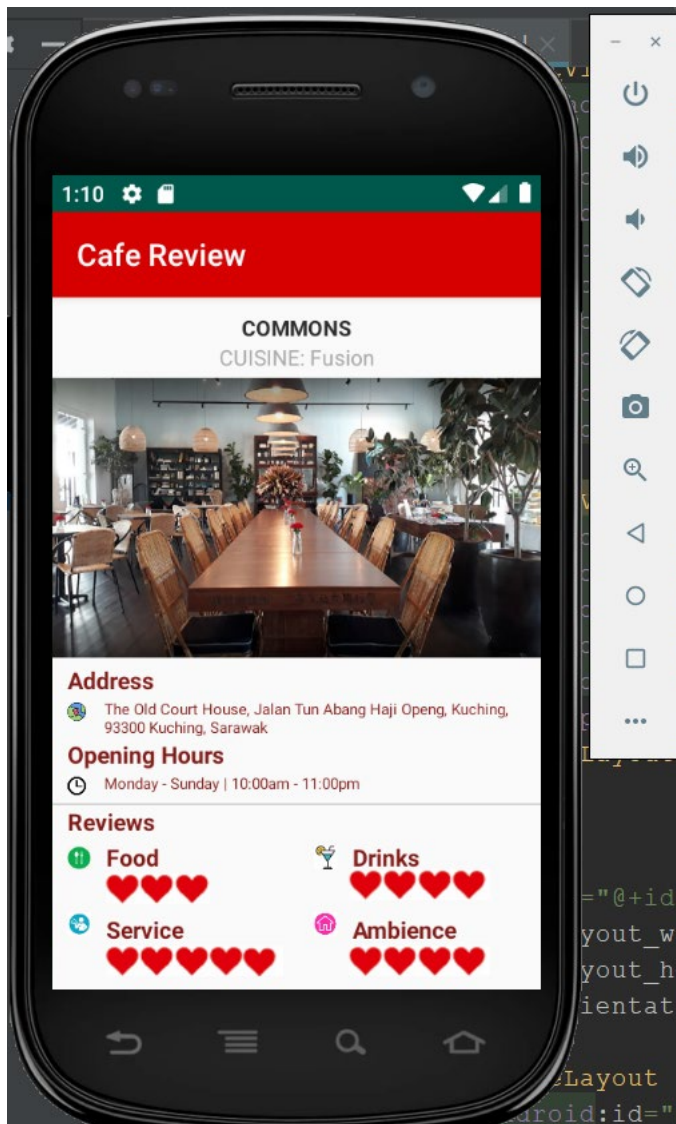
    <TextView
        android:id="@+id/ambienceTextView"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginLeft="10dp"
        android:layout_marginTop="6dp"
        android:layout_toRightOf="@id/ambienceImageView"
        android:text="@string/ambience"
        android:textColor="@color/title"
        android:textSize="15sp"
        android:textStyle="bold" />

    <ImageView
        android:id="@+id/rating4ImageView"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_below="@id/ambienceTextView"
        android:layout_marginStart="43dp"
        app:srcCompat="@drawable/love4_icon" />
</RelativeLayout>
</TableRow>
</TableLayout>
</LinearLayout>

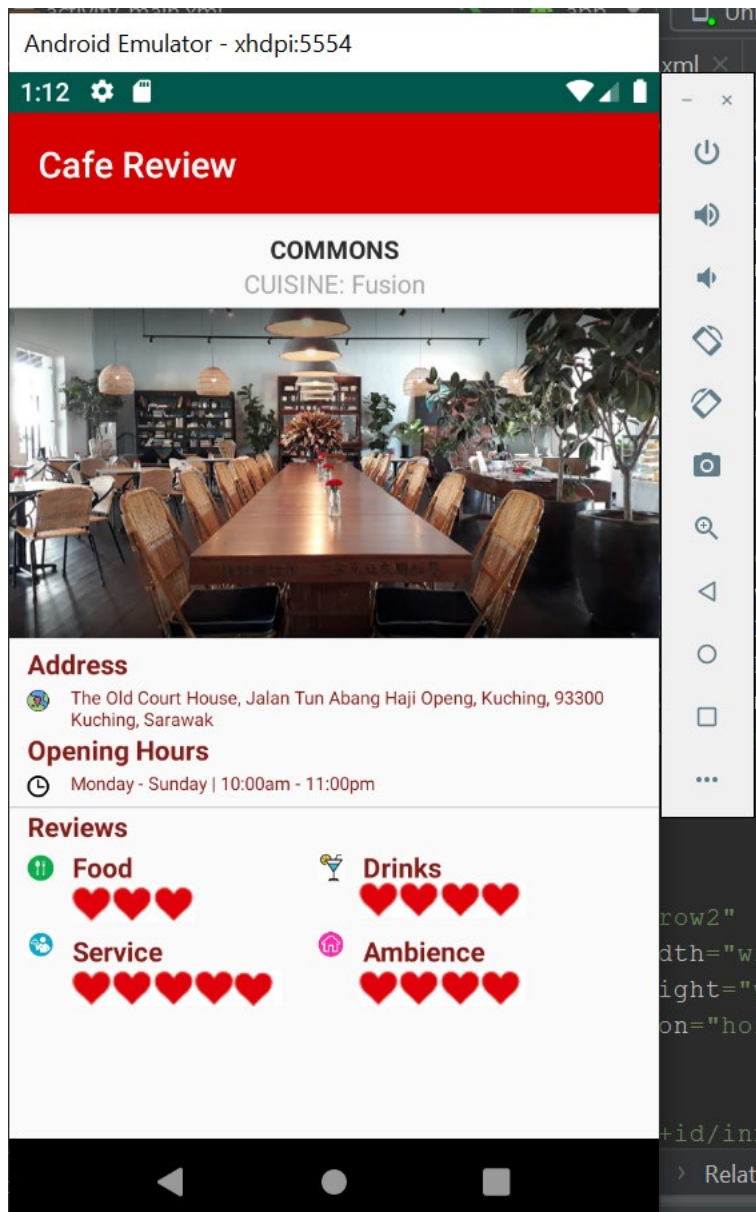
```


Screenshots

hdpi



xhpdj



Sub-task 2.2

XML

```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:android="http://schemas.android.com/apk/res/android"
    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=".MainActivity">

    <TextView
        android:id="@+id/textView_commons"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginTop="10dp"
        android:text="@string/commons"
        android:textStyle="bold"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.5"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent" />

    <TextView
        android:id="@+id/textView_cuisine"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/cuisine"
        android:textColor="@color/cuisine"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.5"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toBottomOf="@id/textView_commons" />

    <ImageView
        android:id="@+id/imageView"
        android:layout_width="wrap_content"
        android:layout_height="180dp"
        android:layout_marginTop="10dp"
        android:contentDescription="@string/img"
        android:scaleType="fitXY"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.5"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toBottomOf="@id/textView_cuisine"
        app:srcCompat="@drawable/commons" />

    <androidx.constraintlayout.widget.Guideline
        android:id="@+id/guideline"
        android:layout_width="wrap_content"
```

```
    android:layout_height="wrap_content"
    android:orientation="vertical"
    app:layout_constraintGuide_percent="0.03125" />
```

```
<TextView
    android:id="@+id/textView_addressTitle"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginTop="8dp"
    android:text="@string/addTitle"
    android:textColor="@color/main"
    android:textStyle="bold"
    app:layout_constraintLeft_toRightOf="@id/guideline"
    app:layout_constraintTop_toBottomOf="@id/imageView" />
```

```
<ImageView
    android:id="@+id/imageView_location"
    android:layout_width="15dp"
    android:layout_height="15dp"
    android:layout_marginTop="3dp"
    app:layout_constraintLeft_toRightOf="@id/guideline"
    app:layout_constraintTop_toBottomOf="@id/textView_addressTitle"
    app:srcCompat="@drawable/location" />
```

```
<TextView
    android:id="@+id/textView_addDetails"
    android:layout_width="260dp"
    android:layout_height="wrap_content"
    android:layout_marginStart="10dp"
    android:layout_marginTop="3dp"
    android:text="@string/addDetails"
    android:textColor="@color/text"
    android:textSize="11sp"
    app:layout_constraintStart_toEndOf="@+id/imageView_location"
    app:layout_constraintTop_toBottomOf="@id/textView_addressTitle" />
```

```
<TextView
    android:id="@+id/textView_openTitle"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/openTitle"
    android:textColor="@color/main"
    android:textStyle="bold"
    app:layout_constraintStart_toEndOf="@id/guideline"
    app:layout_constraintTop_toBottomOf="@id/textView_addDetails" />
```

```
<ImageView
    android:id="@+id/imageView_clock"
    android:layout_width="15dp"
    android:layout_height="15dp"
    android:layout_marginTop="3dp"
```

```
android:contentDescription="@string/clock"
app:layout_constraintStart_toEndOf="@id/guideline"
app:layout_constraintTop_toBottomOf="@id/textView_openTitle"
app:srcCompat="@drawable/clock" />
```

```
<TextView
    android:id="@+id/textView_openDetails"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginStart="10dp"
    android:layout_marginTop="3dp"
    android:text="@string/openDetails"
    android:textColor="@color/text"
    android:textSize="11sp"
    app:layout_constraintStart_toEndOf="@id/imageView_clock"
    app:layout_constraintTop_toBottomOf="@id/textView_openTitle" />
```

```
<LinearLayout
    android:id="@+id/hr"
    android:layout_width="match_parent"
    android:layout_height="1dp"
    android:layout_marginTop="3dp"
    android:background="@color/hr"
    android:orientation="horizontal"
    app:layout_constraintTop_toBottomOf="@id/textView_openDetails"/>
```

```
<TextView
    android:id="@+id/textView_review"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/review"
    android:textColor="@color/main"
    android:textStyle="bold"
    app:layout_constraintStart_toEndOf="@id/guideline"
    app:layout_constraintTop_toBottomOf="@id/hr" />
```

```
<ImageView
    android:id="@+id/imageView_food"
    android:layout_width="20dp"
    android:layout_height="20dp"
    app:layout_constraintStart_toEndOf="@id/guideline"
    app:layout_constraintTop_toBottomOf="@id/textView_review"
    app:srcCompat="@drawable/food_icon" />
```

```
<TextView
    android:id="@+id/textView_food"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginStart="10dp"
    android:text="@string/food"
    android:textColor="@color/main"
```

```
    android:textStyle="bold"
    app:layout_constraintStart_toEndOf="@id/imageView_food"
    app:layout_constraintTop_toBottomOf="@id/textView_review" />
```

```
<ImageView
    android:id="@+id/imageView_rating1"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    app:layout_constraintLeft_toLeftOf="@id/textView_food"
    app:layout_constraintTop_toBottomOf="@id/textView_food"
    app:srcCompat="@drawable/love3_icon" />
```

```
<ImageView
    android:id="@+id/imageView_service"
    android:layout_width="20dp"
    android:layout_height="20dp"
    app:srcCompat="@drawable/service_icon"
    android:layout_marginTop="10dp"
    app:layout_constraintStart_toEndOf="@id/guideline"
    app:layout_constraintTop_toBottomOf="@id/imageView_rating1"/>
```

```
<TextView
    android:id="@+id/textView_service"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/service"
    android:textStyle="bold"
    android:textColor="@color/main"
    android:layout_marginStart="10dp"
    android:layout_marginTop="10dp"
    app:layout_constraintStart_toEndOf="@id/imageView_service"
    app:layout_constraintTop_toBottomOf="@id/imageView_rating1"
    />
```

```
<ImageView
    android:id="@+id/imageView_rating2"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    app:srcCompat="@drawable/love5_icon"
    app:layout_constraintTop_toBottomOf="@id/textView_service"
    app:layout_constraintLeft_toLeftOf="@id/textView_service"
    />
```

```
<androidx.constraintlayout.widget.Barrier
    android:id="@+id/barrier"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    app:barrierDirection="end"
```

```
app:constraint_referenced_ids="imageView_food,textView_food,imageView_rating1,imageVi
```

```
ew_service,textView_service,imageView_rating2"
    app:layout_constraintStart_toEndOf="@id/imageView_rating1" />
```

```
<ImageView
    android:id="@+id/imageView_drinks"
    android:layout_width="20dp"
    android:layout_height="20dp"
    android:layout_marginStart="10dp"
    app:layout_constraintStart_toEndOf="@id/barrier"
    app:layout_constraintTop_toBottomOf="@id/textView_review"
    app:srcCompat="@drawable/drinks_icon" />
```

```
<TextView
    android:id="@+id/textView_drinks"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/drinks"
    android:textStyle="bold"
    android:textColor="@color/main"
    android:layout_marginStart="10dp"
    app:layout_constraintStart_toEndOf="@id/imageView_drinks"
    app:layout_constraintTop_toBottomOf="@id/textView_review"/>
```

```
<ImageView
    android:id="@+id/imageView_rating3"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    app:srcCompat="@drawable/love4_icon"
    app:layout_constraintTop_toBottomOf="@id/textView_drinks"
    app:layout_constraintLeft_toLeftOf="@id/textView_drinks"/>
```

```
<ImageView
    android:id="@+id/imageView_ambience"
    android:layout_width="20dp"
    android:layout_height="20dp"
    android:layout_marginTop="10dp"
    android:layout_marginStart="10dp"
    app:layout_constraintStart_toEndOf="@id/barrier"
    app:layout_constraintTop_toBottomOf="@id/imageView_rating1"
    app:srcCompat="@drawable/ambience_icon" />
```

```
<TextView
    android:id="@+id/textView_ambience"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/ambience"
    android:textStyle="bold"
    android:textColor="@color/main"
    android:layout_marginTop="10dp"
    android:layout_marginStart="10dp"
    app:layout_constraintStart_toEndOf="@id/imageView_ambience"
```

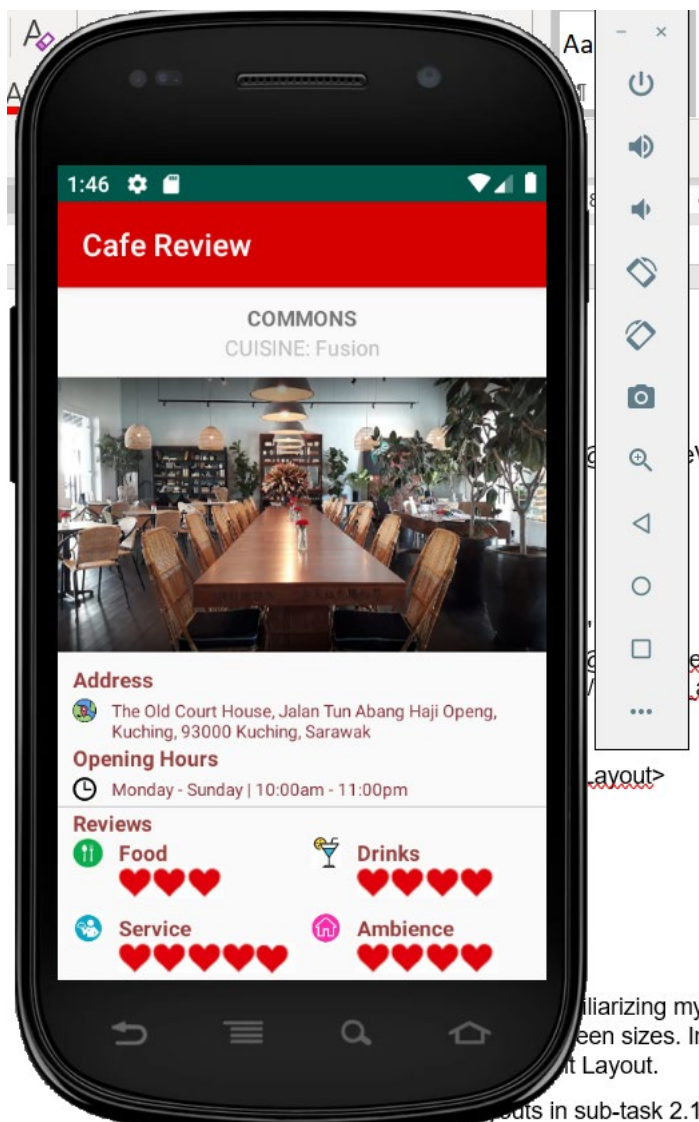
```
app:layout_constraintTop_toBottomOf="@id/imageView_rating3"/>
```

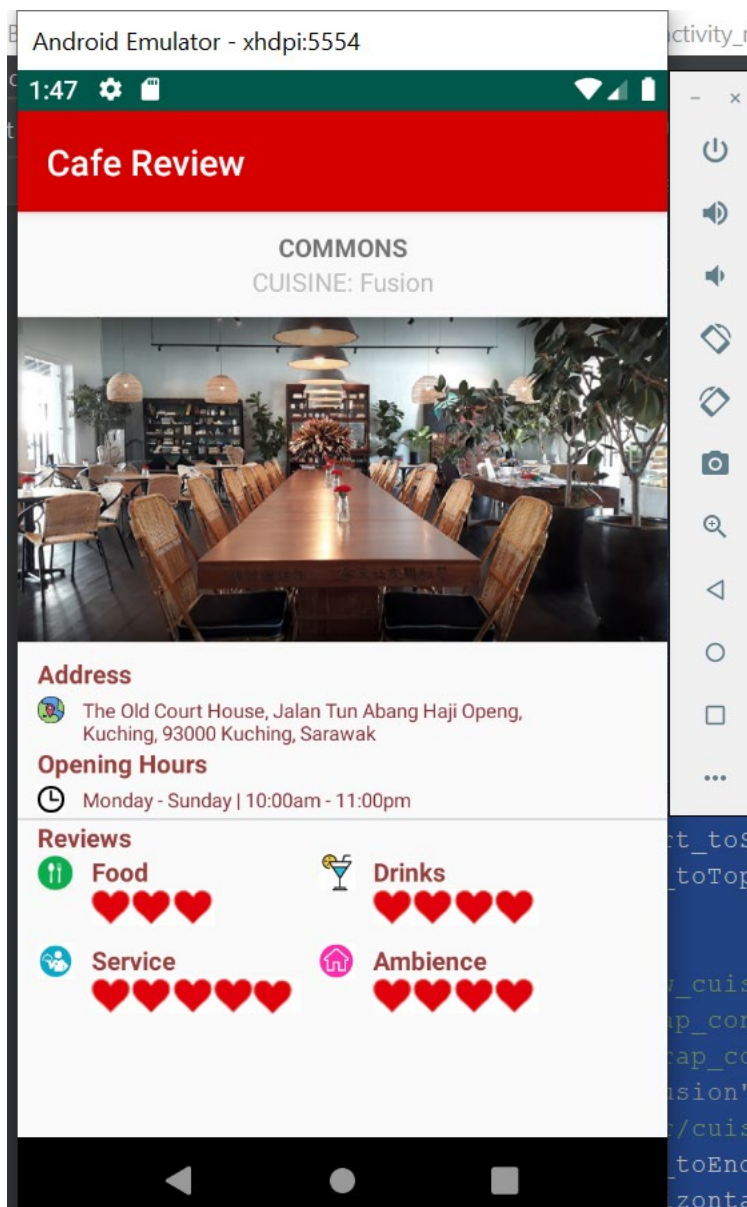
```
<ImageView  
    android:id="@+id/imageView_rating4"  
    android:layout_width="wrap_content"  
    android:layout_height="wrap_content"  
    app:srcCompat="@drawable/love4_icon"  
    app:layout_constraintTop_toBottomOf="@id/textView_ambience"  
    app:layout_constraintLeft_toLeftOf="@id/textView_ambience"/>
```

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

Screenshot

hdpi



xhdpi

Sub-task 2.3

For sub-task 2.1, I faced much challenge familiarizing myself with nested layouts as well setting up of different layouts for different screen sizes. In sub-task 2.2, I faced some difficulty understanding the use of Constraint Layout.

The strength of using a mixture of layouts in sub-task 2.1, I believe is that it provides more customization, however, its weakness is that it is much more tedious to do and is time consuming.

In sub-task 2.2, using Constraint Layout, its strength is that it allows me to quickly build the layout for the application in a drag and drop manner. I see very little weakness in using solely Constraint Layout.

Task 3

“Separation of concerns” is a software engineering design principle that emphasizes the division of a software system into smaller isolated chunks, where the functionalities of each chunk overlap very little with other chunks and each chunk is responsible for a single concern. A concern denotes a feature in a software system. It practices low coupling, in which the dependency between two functions are low, and high cohesion, in which quality the function performs its task is high.

With respect to UI, the underlying principle of separation of concern is to separate the values applied to the UI from its implementation.

Take for example in Task 2, the string values are stored in the string values xml file and in place in the implementation is its code to link the value to the implementation in the activity main xml file. The same can be said for colors. If we were to change the string or the color values, we only need to navigate the string and color xml files and edit the values; the implementation is not touched.

References

Shah, S 2017?, "*Adapter pattern*", GeeksforGeeks, viewed 17 September 2019, <<https://www.geeksforgeeks.org/adapter-pattern/>>.

Mgbemena, C 2017, "*Android design patterns: the singleton pattern*", envatotuts+, viewed 17 September 2019, <<https://code.tutsplus.com/tutorials/android-design-patterns-the-singleton-pattern--cms-29153>>.

Gupta, L 2014?, "*Builder design pattern in java*", howtodoinjava, viewed 17 September 2019, <<https://howtodoinjava.com/design-patterns/creational/builder-pattern-in-java/>>.

Makabee, H 2012, "*Separation of concerns*", Effective Software Design, viewed 17 September 2019, <<https://effectivesoftwaredesign.com/2012/02/05/separation-of-concerns/>>.

Ayub, N 2017, "*Android list view example*", JavaTutorial, viewed 25 September 2019, <<https://javatutorial.net/android-list-view-example>>.