Mobile Application Development

Google Maps

Google Maps

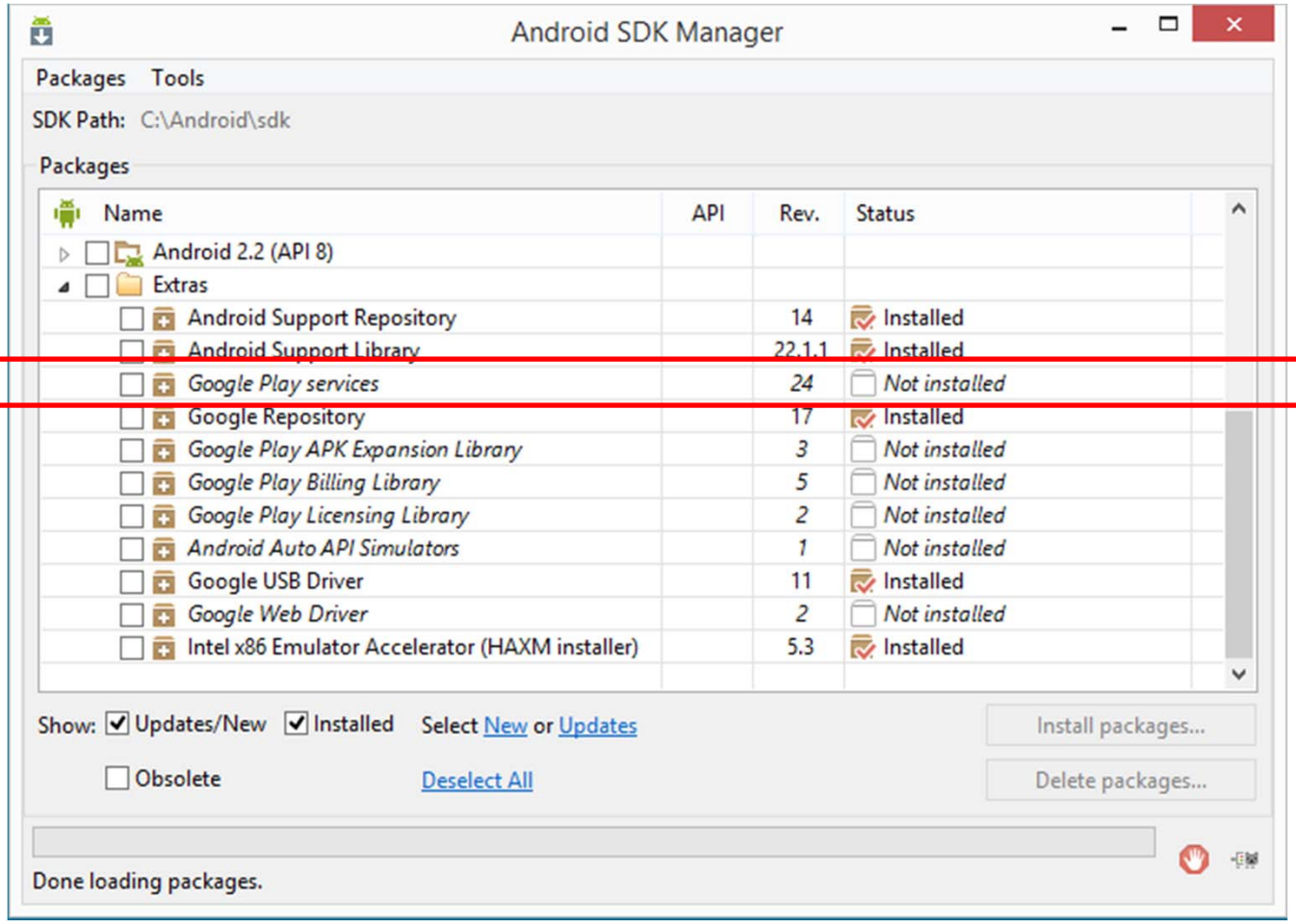
- Set Up
  - Install **Google Play Services SDK** & **Google APIs**
  - Create a **Virtual Device** that uses “Google APIs” Platform
- Create Your App
  - Get an **App Certificate** and the **Google Maps API Key**
  - **Add Google Play Services to Your Project**
  - Specify app settings in the **AndroidManifest.xml**
  - Add a **Map**

SETTING UP
GOOGLE PLAY SERVICES

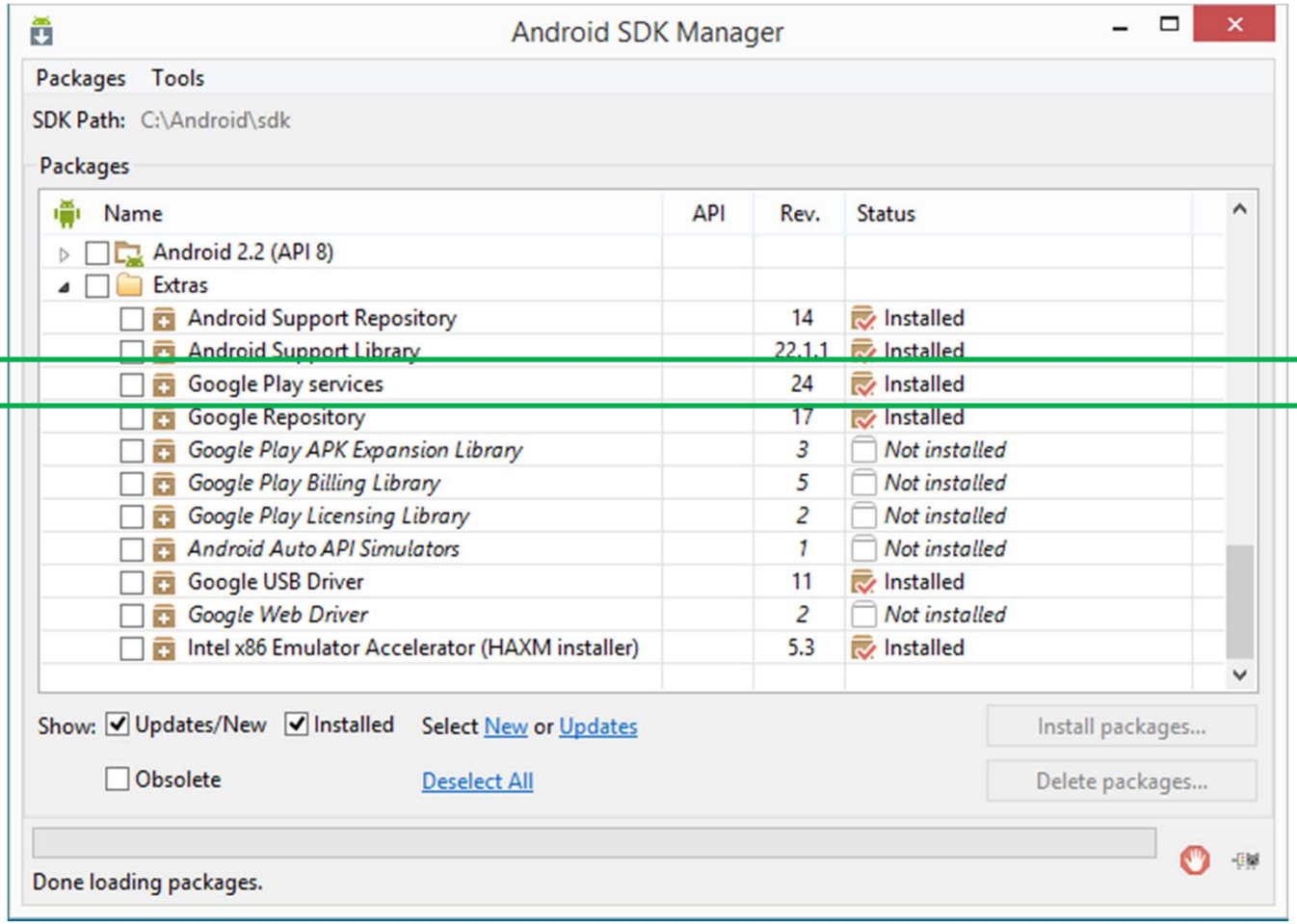
Install Google Play Services SDK

- Google Maps Android API v2 is part of the Google Play services platform. To use Google Maps, set up the Google Play services SDK.
  - Open SDK Manager
  - Under “Extras”, see if “Google Play Services” is installed

Install Google Play Services SDK



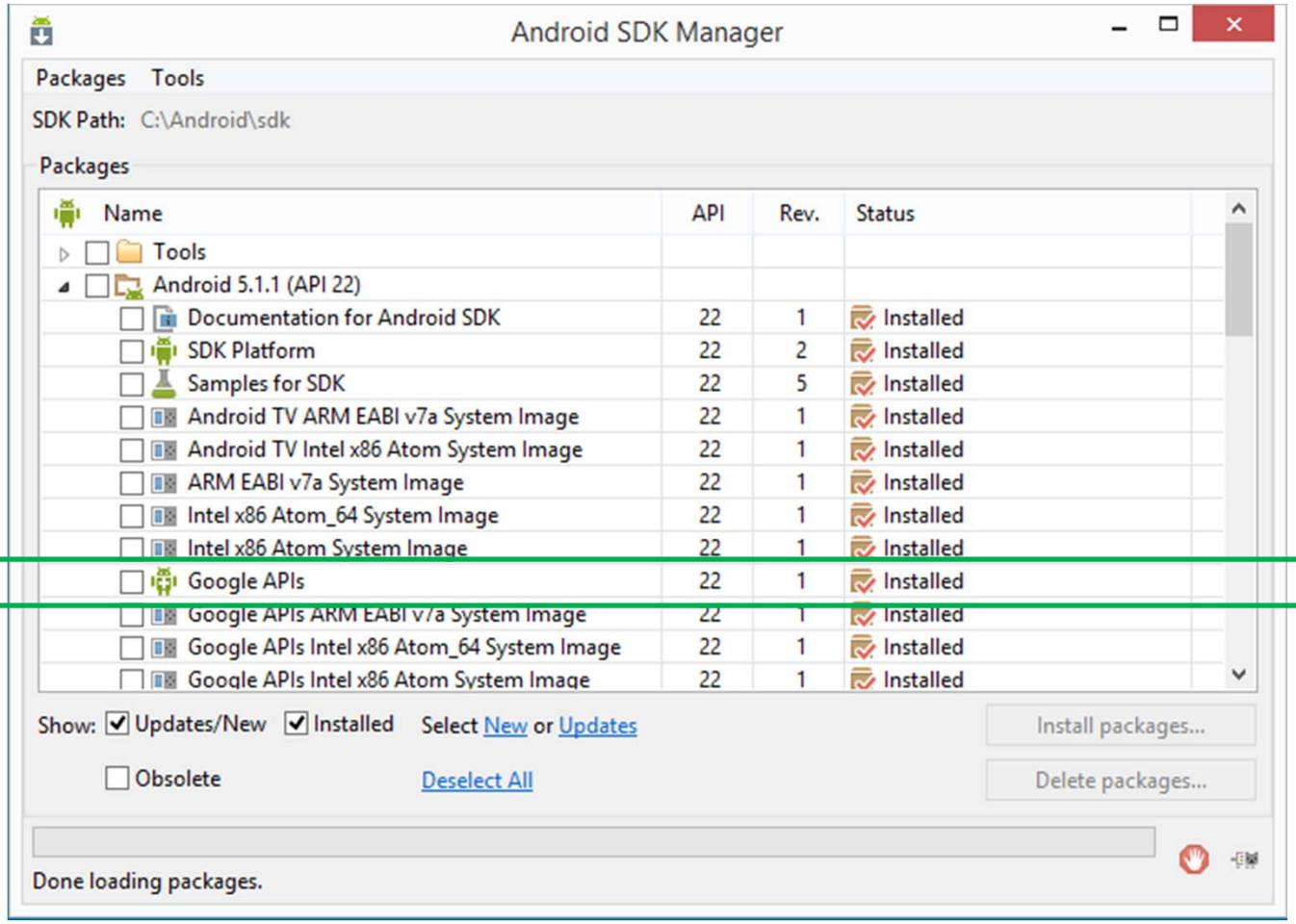
Install Google Play Services SDK



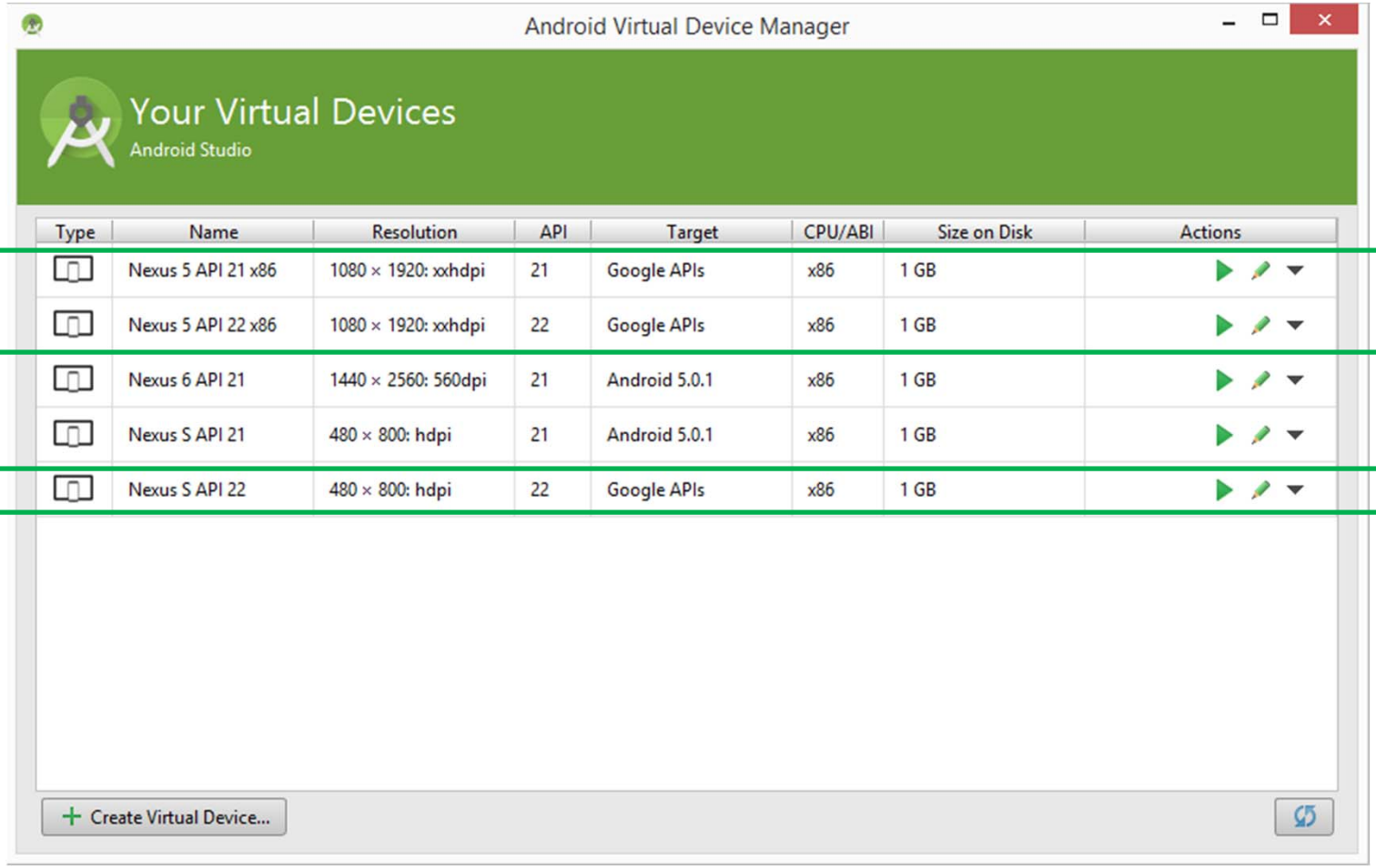
Install Google APIs

- To test your app when using the Google Play services SDK, you must use either:
  - A compatible **Android device that runs Android 2.3 or higher** and includes **Google Play Store**.
  - The **Android emulator** with an AVD that runs the **Google APIs platform** based on Android 4.2.2 or higher.

Install Google APIs



Virtual Device (Google APIs)



INTEGRATING GOOGLE MAPS IN YOUR APPS

Google Maps

- Set Up
  - Install **Google Play Services SDK** & **Google APIs** 
  - Create a **Virtual Device** that uses “Google APIs” Platform 
- Create Your App
  - Get an **App Certificate** and the **Google Maps API Key**
  - **Add Google Play Services to Your Project**
  - Specify app settings in the **AndroidManifest.xml**
  - Add a **Map**

Create Your App

- To access the Google Maps servers with the Maps API, you have to add a **Maps API key** to your application.
- You obtain a Maps API key from the **Google Developers Console** by providing your application's signing certificate and its package name.

Create Your App

- Obtaining a Google Maps API Key for your application requires the following steps:
  - Retrieve information about your **Application's Certificate**.
  - **Register a project in the Google Developers Console** and add the Maps API as a service for the project.
  - **Request Google Maps API Key** for your project.

Retrieve Application’s Certificate

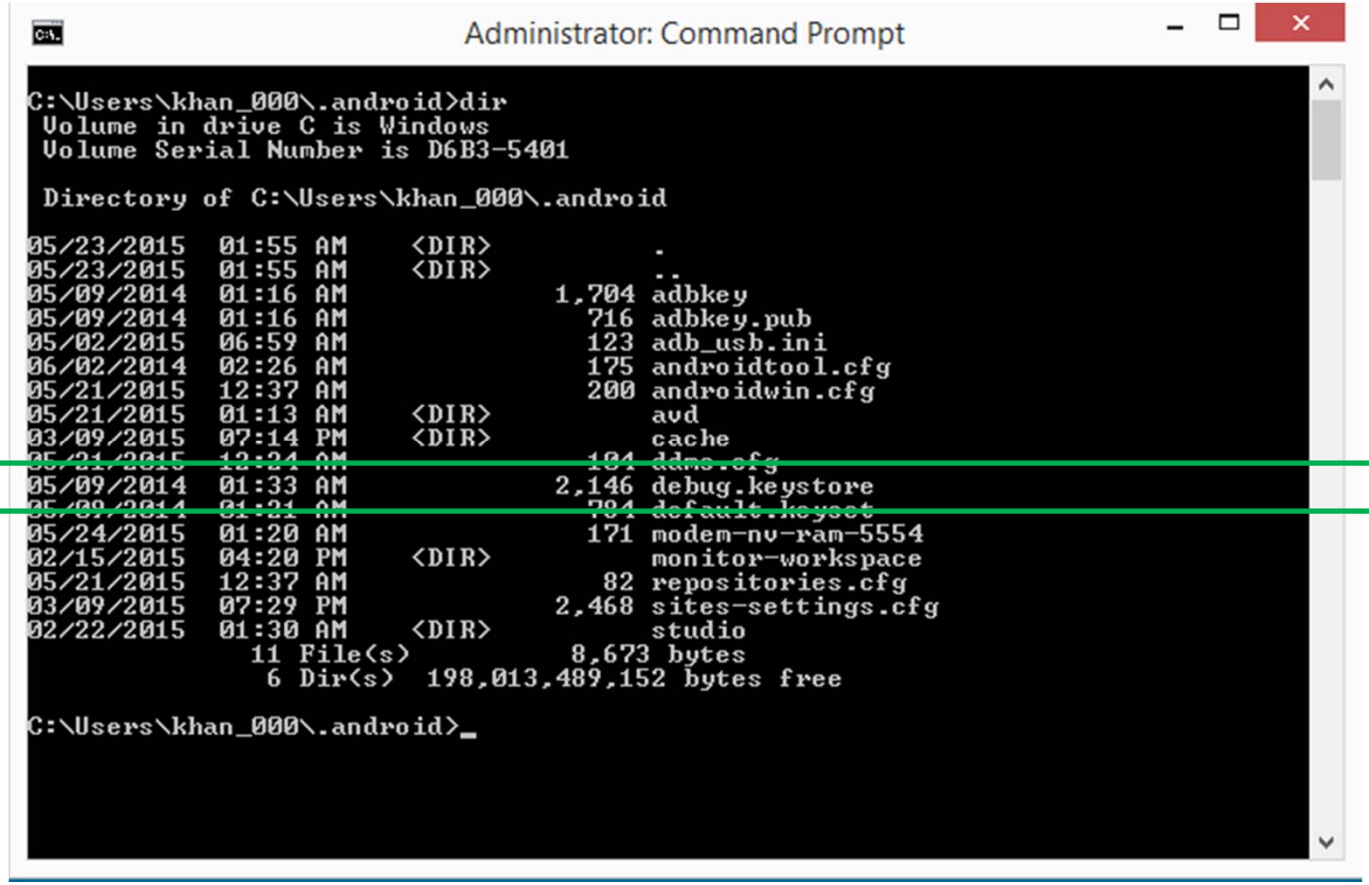
- Your application's digital certificate (known as its SHA-1 fingerprint), is a unique text string generated from the commonly-used SHA-1 hashing algorithm.

- For development purposes, you need to get debug certificate fingerprint. To displaying the debug certificate fingerprint:

  - Locate your debug keystore file. The file name is **debug.keystore**, and is created the first time you build project.

  - On Windows you will typically find this file in this location: C:\Users\your_user_name\.android\

Retrieve Application's Certificate

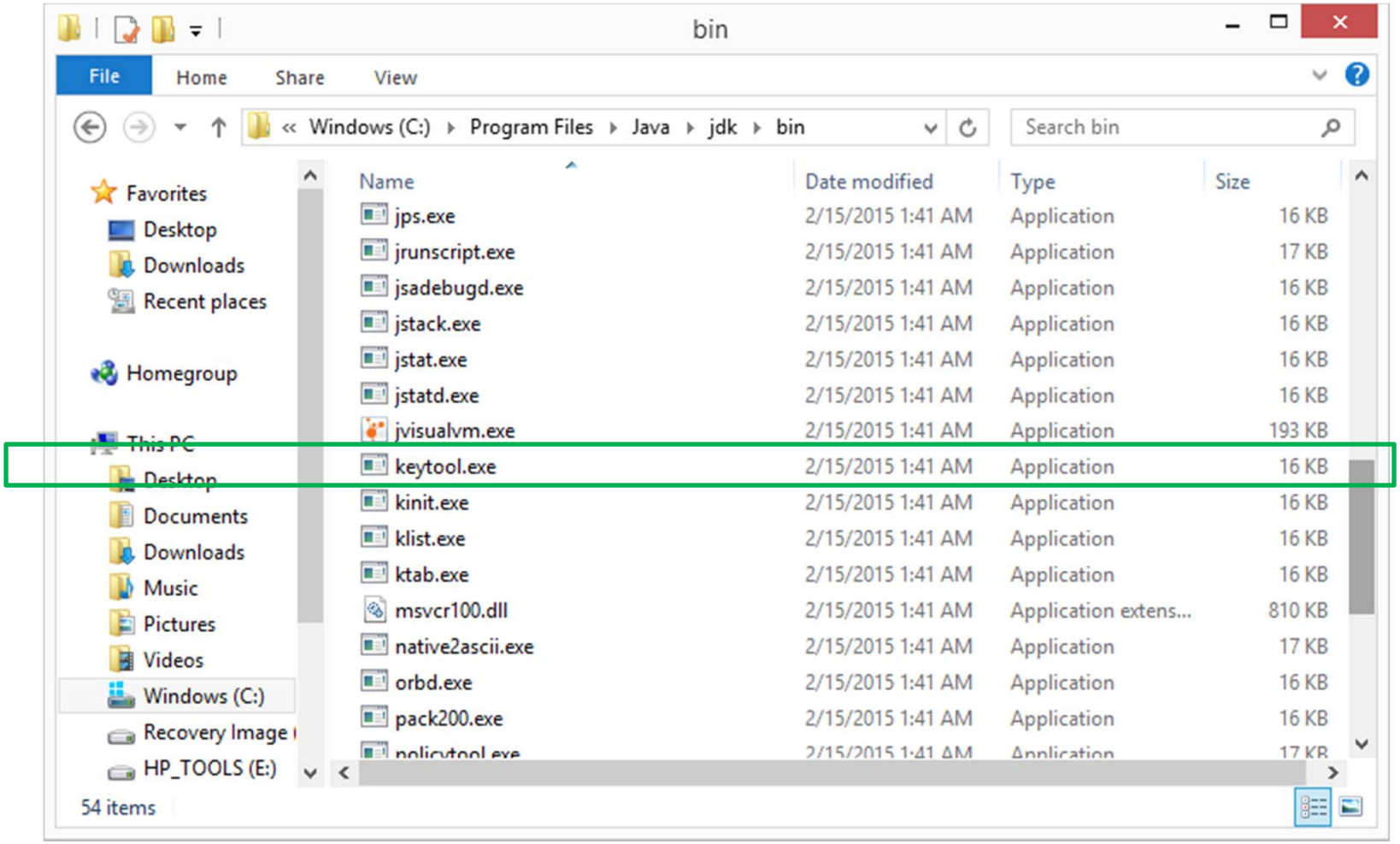


Retrieve Application's Certificate

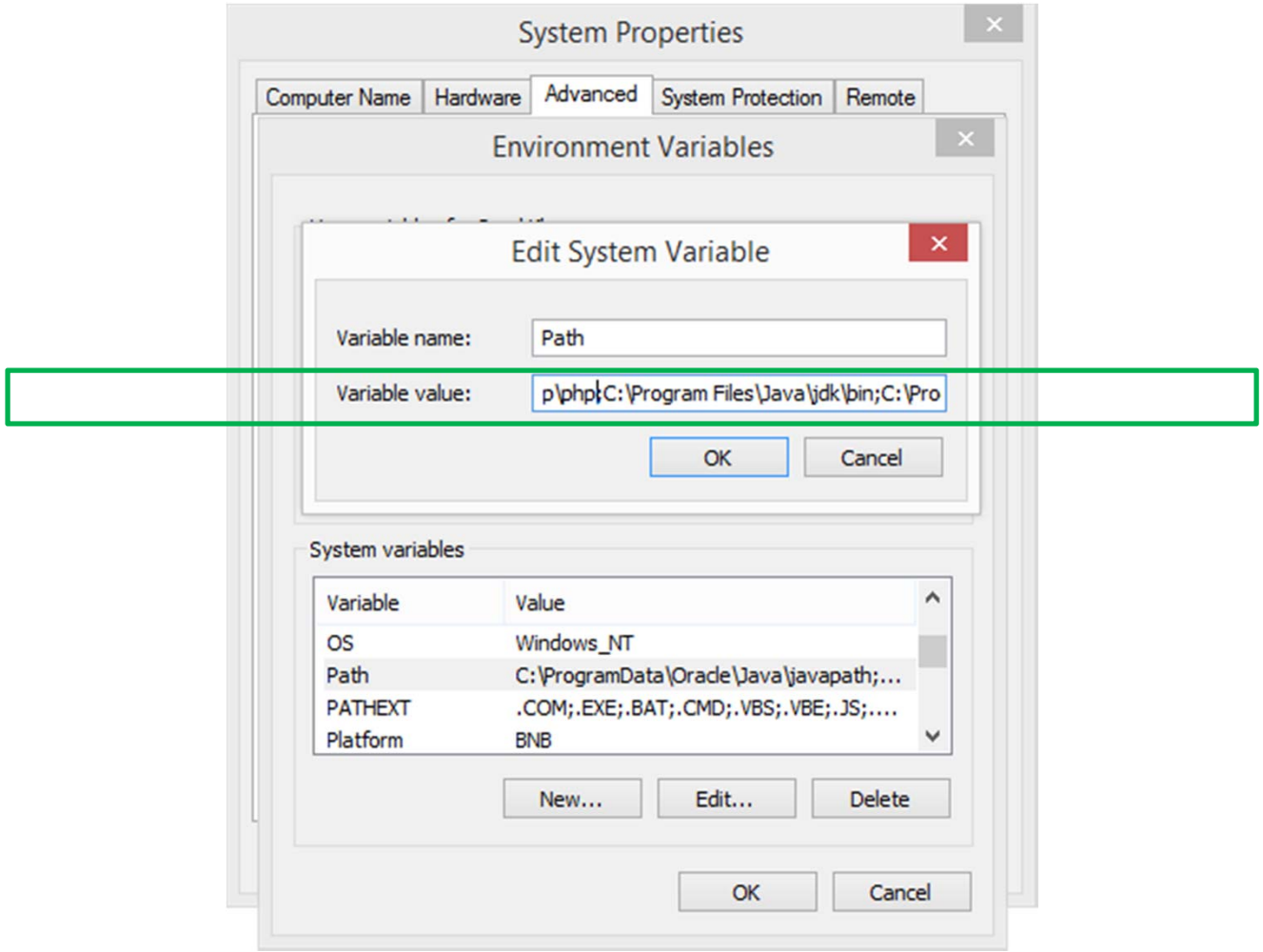
- You can display a certificate's SHA-1 fingerprint using the **keytool program**.

- Keytool program is located in your JDK's "bin" folder. In order to use this program from other locations, you will need to **set JDK's "bin" folder path in your system's environment variables**.

Retrieve Application's Certificate



Retrieve Application's Certificate



Retrieve Application's Certificate

- Once you have **located debug.keystore** and are able to use **keytool program** in its folder, type the following command:

```
keytool -list -v -keystore "%USERPROFILE%\.android\debug.keystore" -
alias androiddebugkey -storepass android -keypass android
```

- To **save output in a text file**, type the following command:

```
keytool -list -v -keystore "%USERPROFILE%\.android\debug.keystore" -
alias androiddebugkey -storepass android -keypass android >
somefilename.txt
```

Retrieve Application's Certificate

- You should see output similar to this:

```
Alias name: androiddebugkey
Creation date: Jan 01, 2013
Entry type: PrivateKeyEntry
Certificate chain length: 1
Certificate[1]:
Owner: CN=Android Debug, O=Android, C=US
Issuer: CN=Android Debug, O=Android, C=US
Serial number: 4aa9b300
Valid from: Mon Jan 01 08:04:04 UTC 2013 until: Mon Jan 01 18:04:04 PST
2033
Certificate fingerprints:
     MD5:  AE:9F:95:D0:A6:86:89:BC:A8:70:BA:34:FF:6A:AC:F9
     SHA1: BB:0D:AC:74:D3:21:E1:43:07:71:9B:62:90:AF:A1:66:6E:44:5D:75
     Signature algorithm name: SHA1withRSA
     Version: 3
```

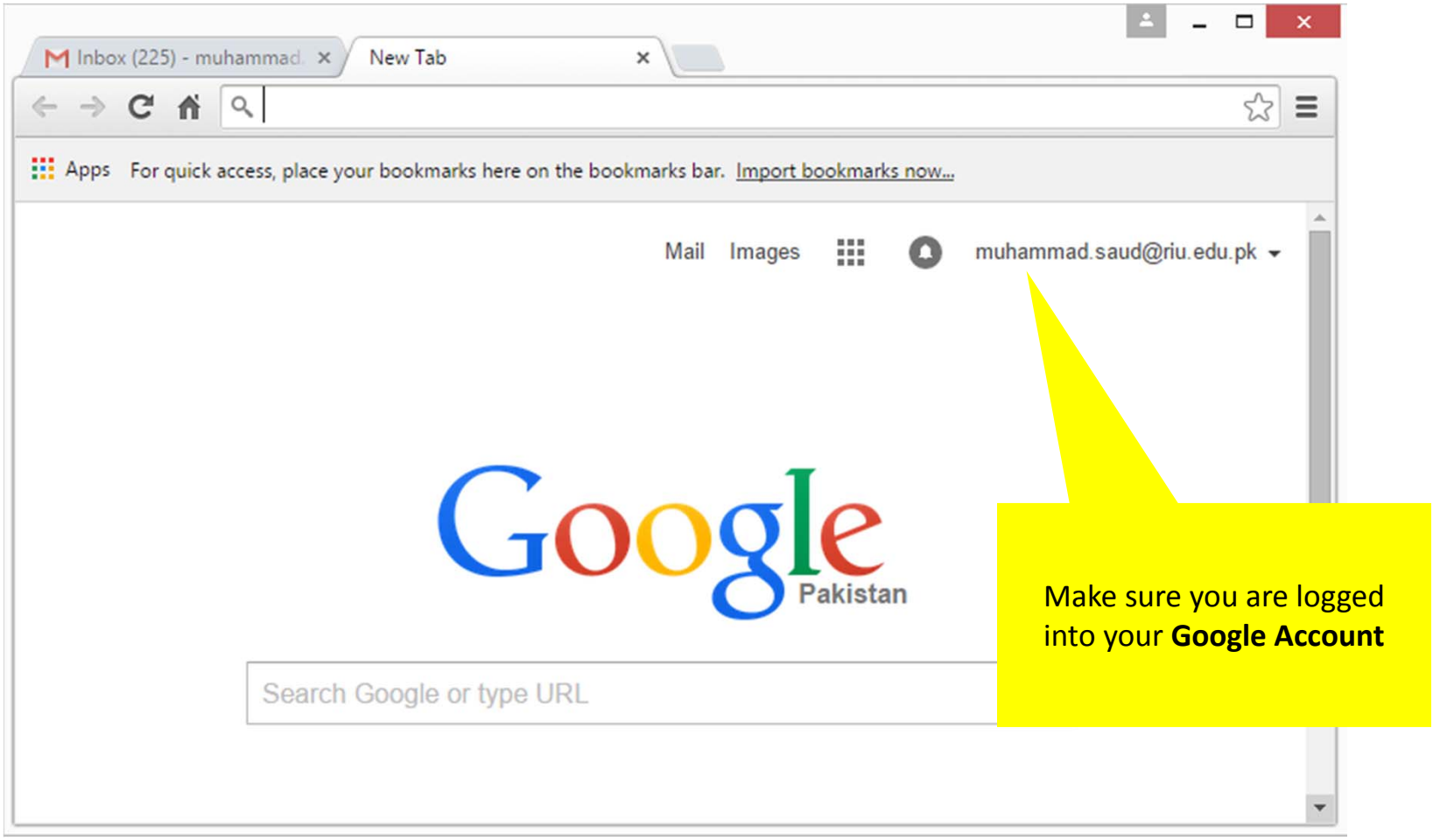
Create Your App

- Obtaining a Google Maps API Key for your application requires the following steps:
  - Retrieve information about your **Application's Certificate**. 
  - **Register a project in the Google Developers Console** and add the Maps API as a service for the project.
  - **Request Google Maps API Key** for your project.

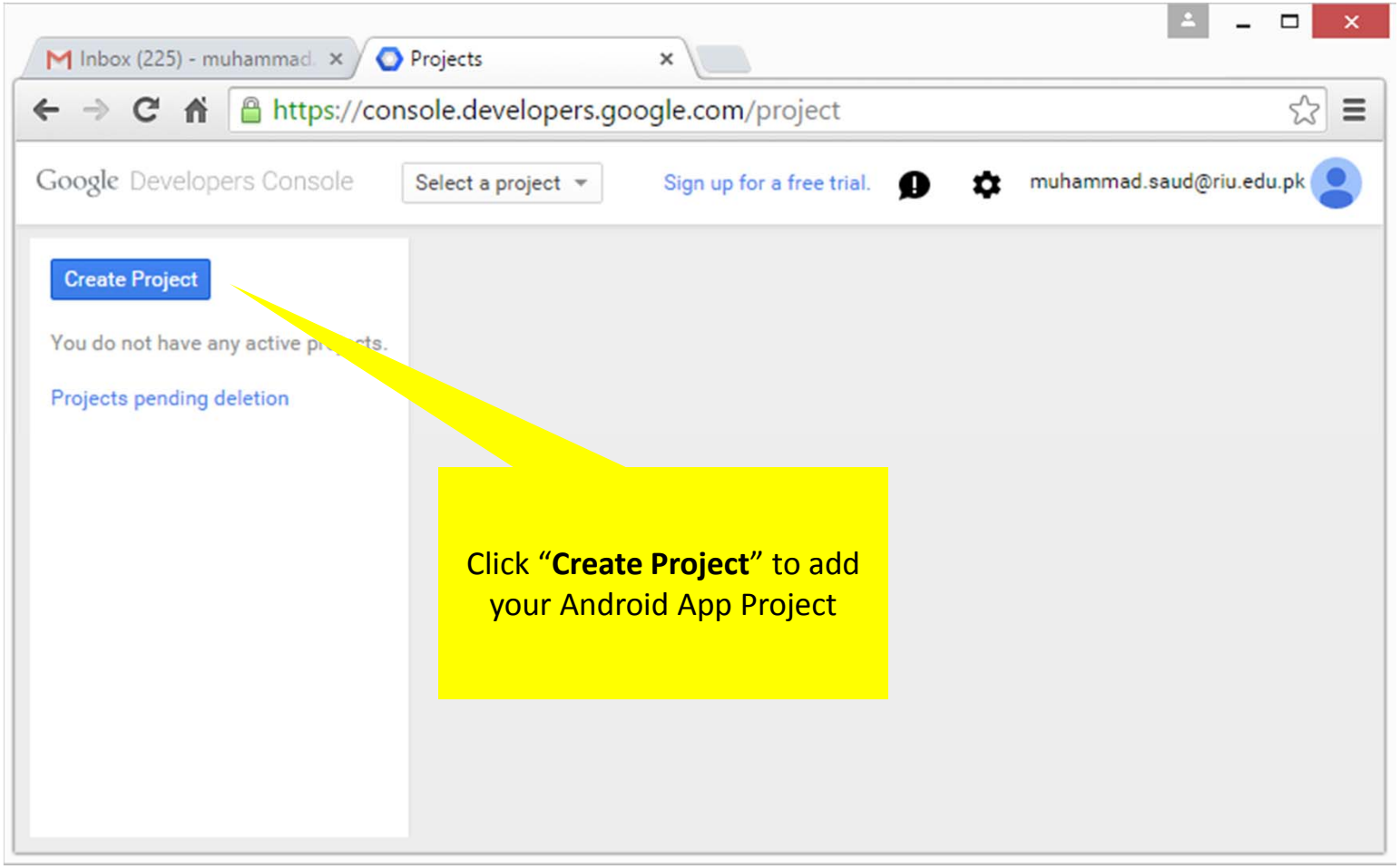
Google Developers Console

- Follow these steps to create or modify a project for your application in the Google Developers Console and enable the Google Maps Android API.
  - Go to the Google Developers Console: https://console.developers.google.com/
  - Select a project, or create a new one.
  - In the sidebar on the left, **expand APIs & auth**.
    - Next, **click APIs**.
    - Select the Enabled APIs link in the API section to see a list of all your enabled APIs. Make sure that the API is on the list of enabled APIs. If you have not enabled it, select the API from the list of APIs, then select the **Enable API button for the API**.
    - The only API you need is the Google Maps Android API, although you can choose to enable other APIs for the same project too.
  - In the sidebar on the left, **select Credentials**.

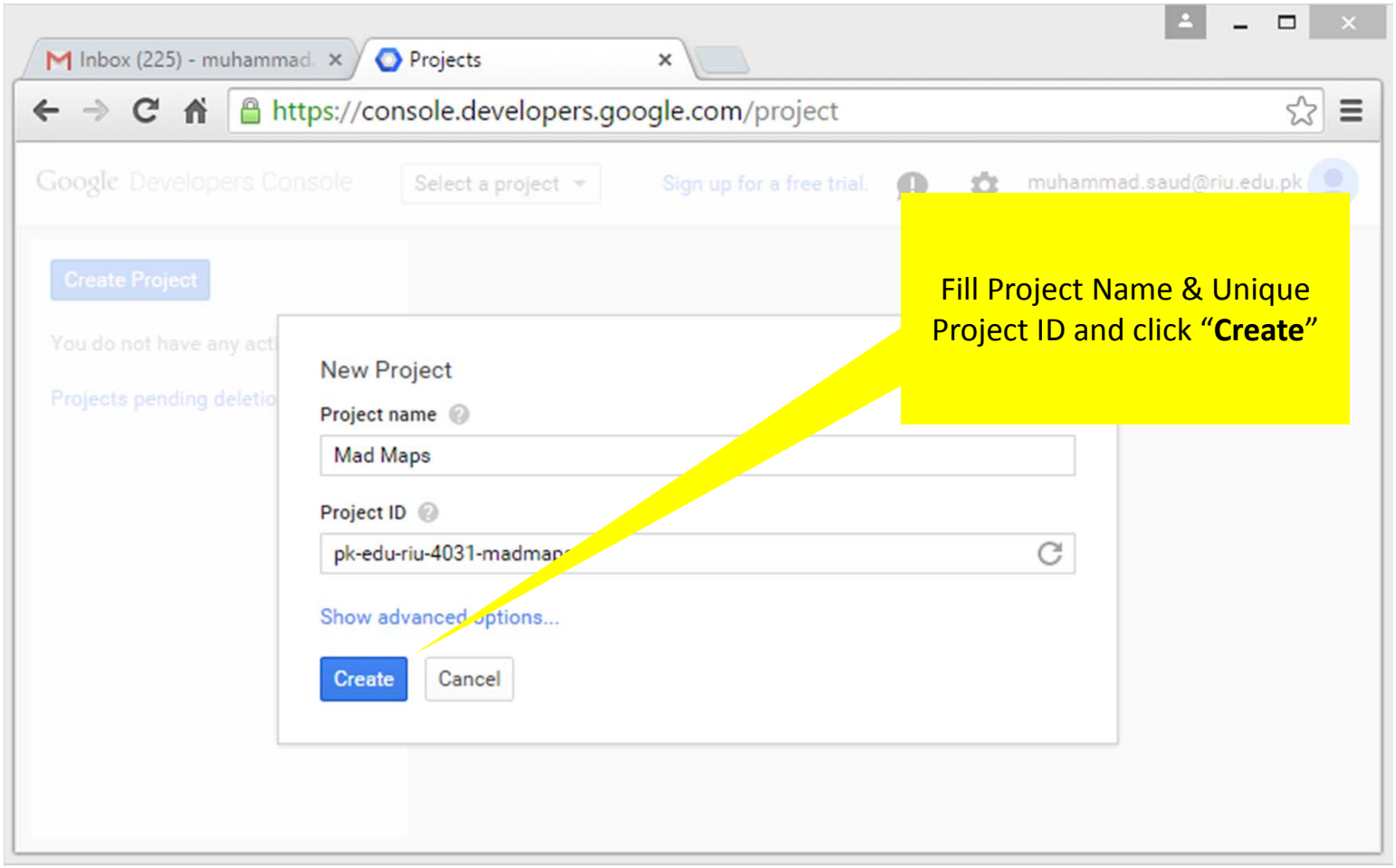
Google Developers Console



Google Developers Console



Google Developers Console



Google Developers Console

- Follow these steps to create or modify a project for your application in the Google Developers Console and enable the Google Maps Android API.

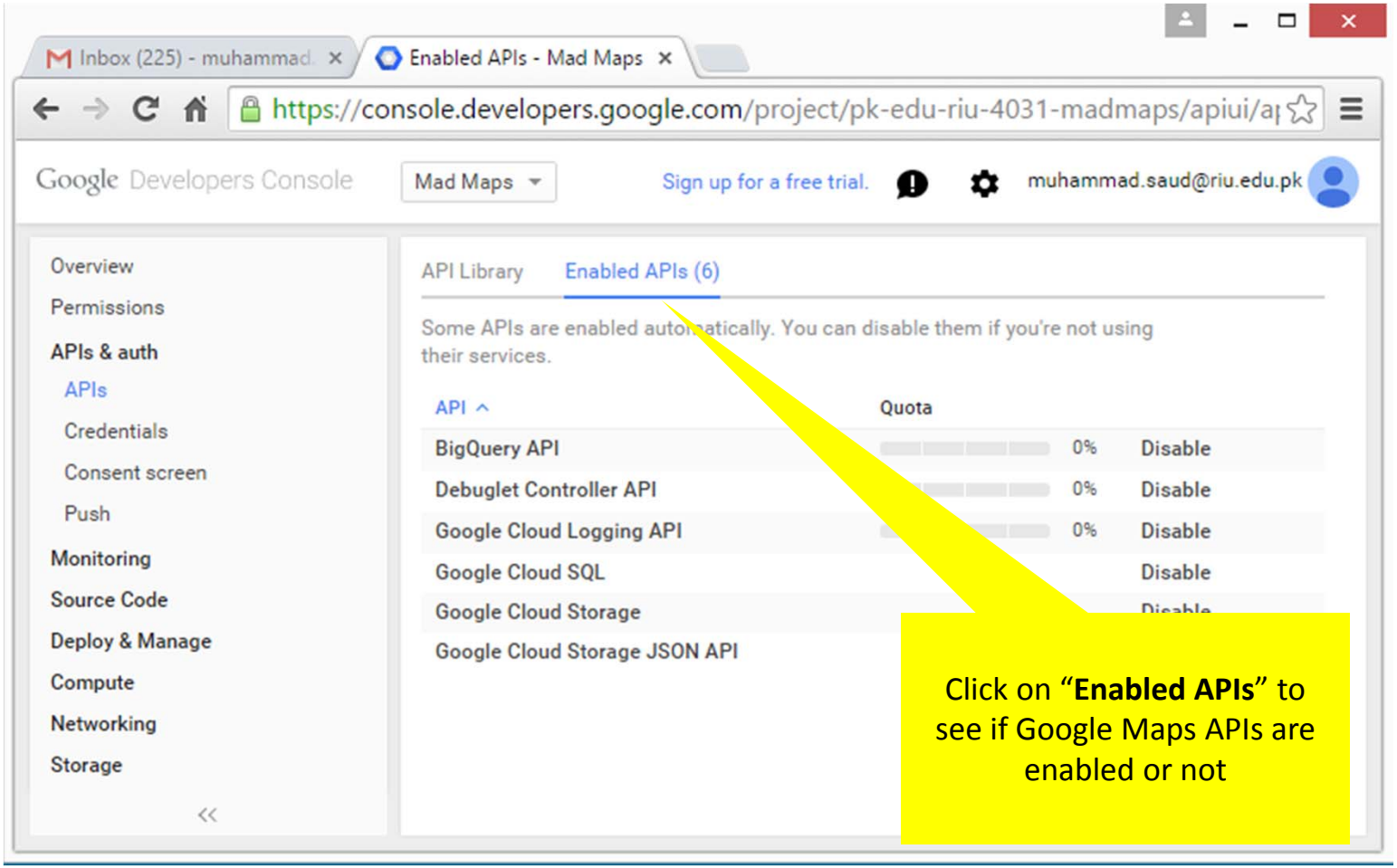
  - Go to the Google Developers Console: https://console.developers.google.com/

  - Select a project, or create a new one.

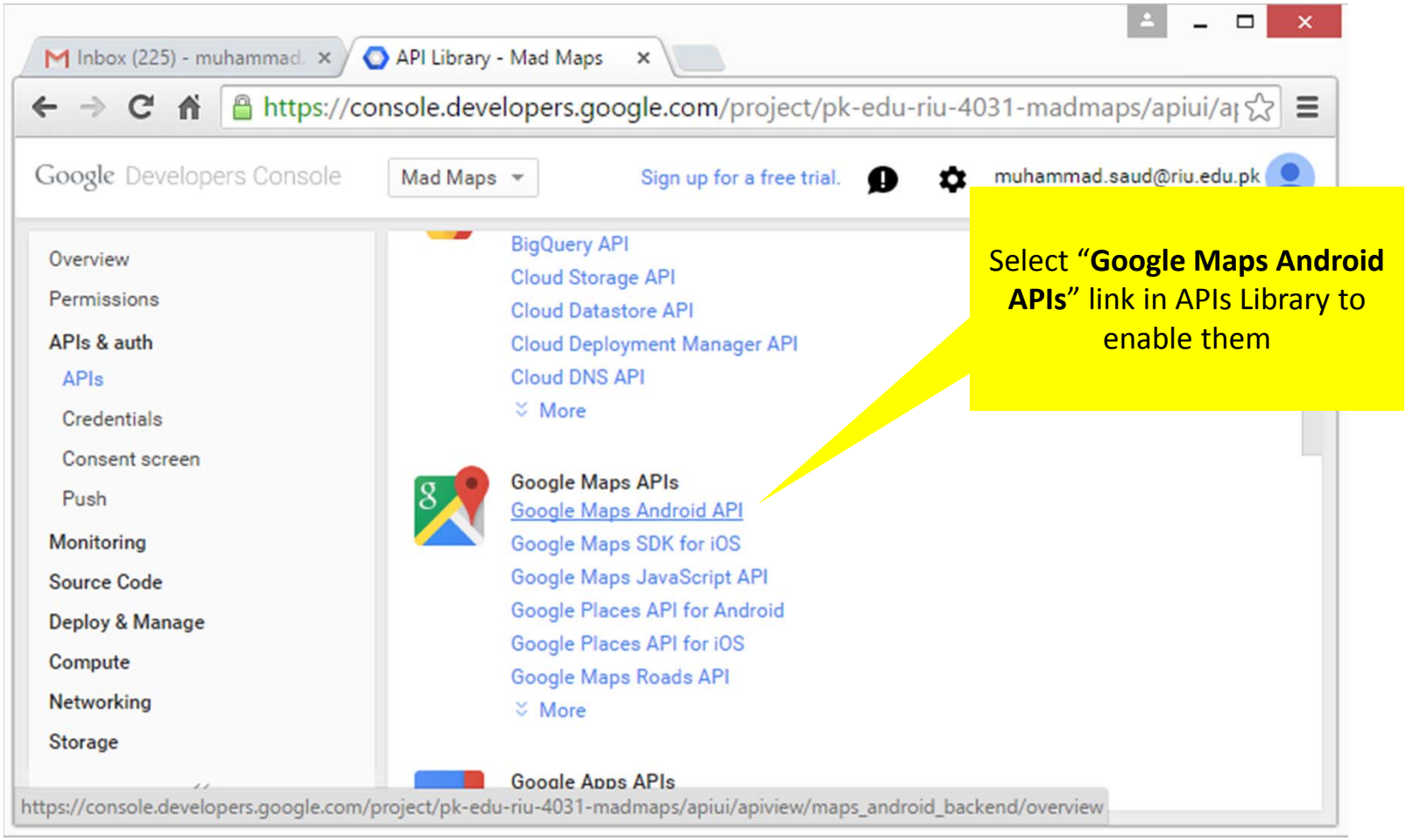
  - In the sidebar on the left, **expand APIs & auth**.
    - Next, **click APIs**.
    - Select the Enabled APIs link in the API section to see a list of all your enabled APIs. Make sure that the API is on the list of enabled APIs. If you have not enabled it, select the API from the list of APIs, then select the **Enable API button for the API**.
    - The only API you need is the Google Maps Android API, although you can choose to enable other APIs for the same project too.

  - In the sidebar on the left, **select Credentials**.

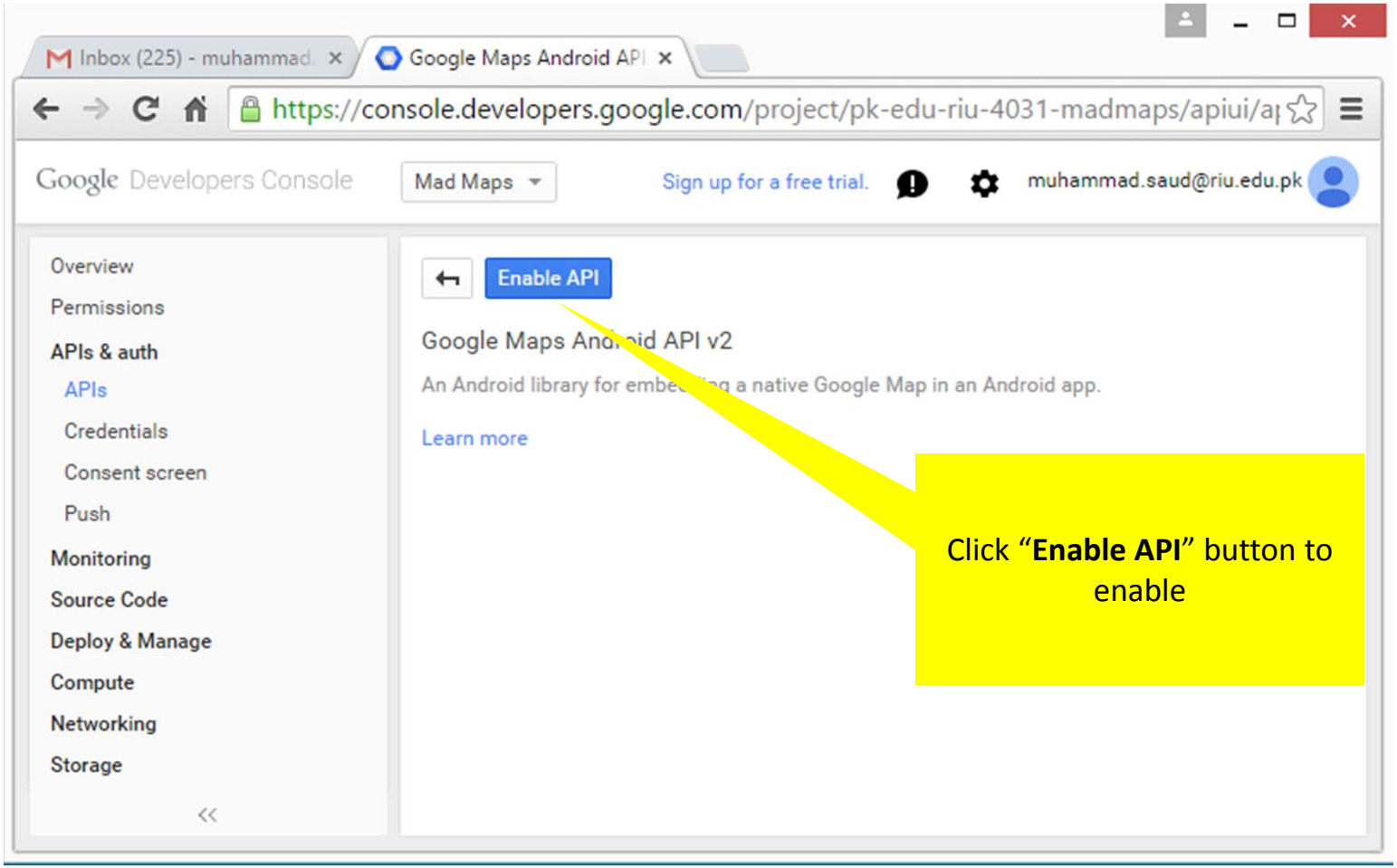
Google Developers Console



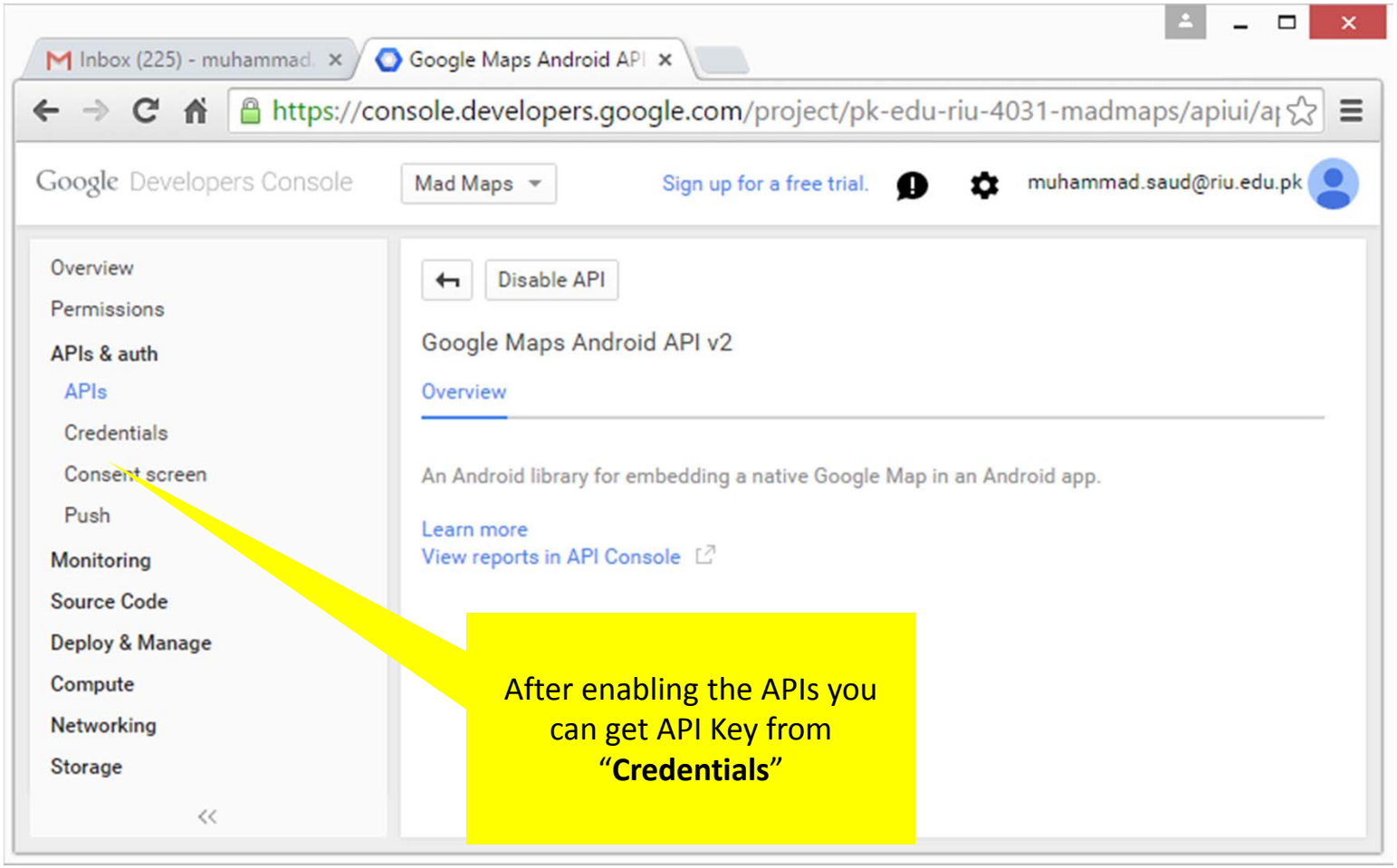
Google Developers Console



Google Developers Console



Google Developers Console



Google Developers Console

- Follow these steps to create or modify a project for your application in the Google Developers Console and enable the Google Maps Android API.

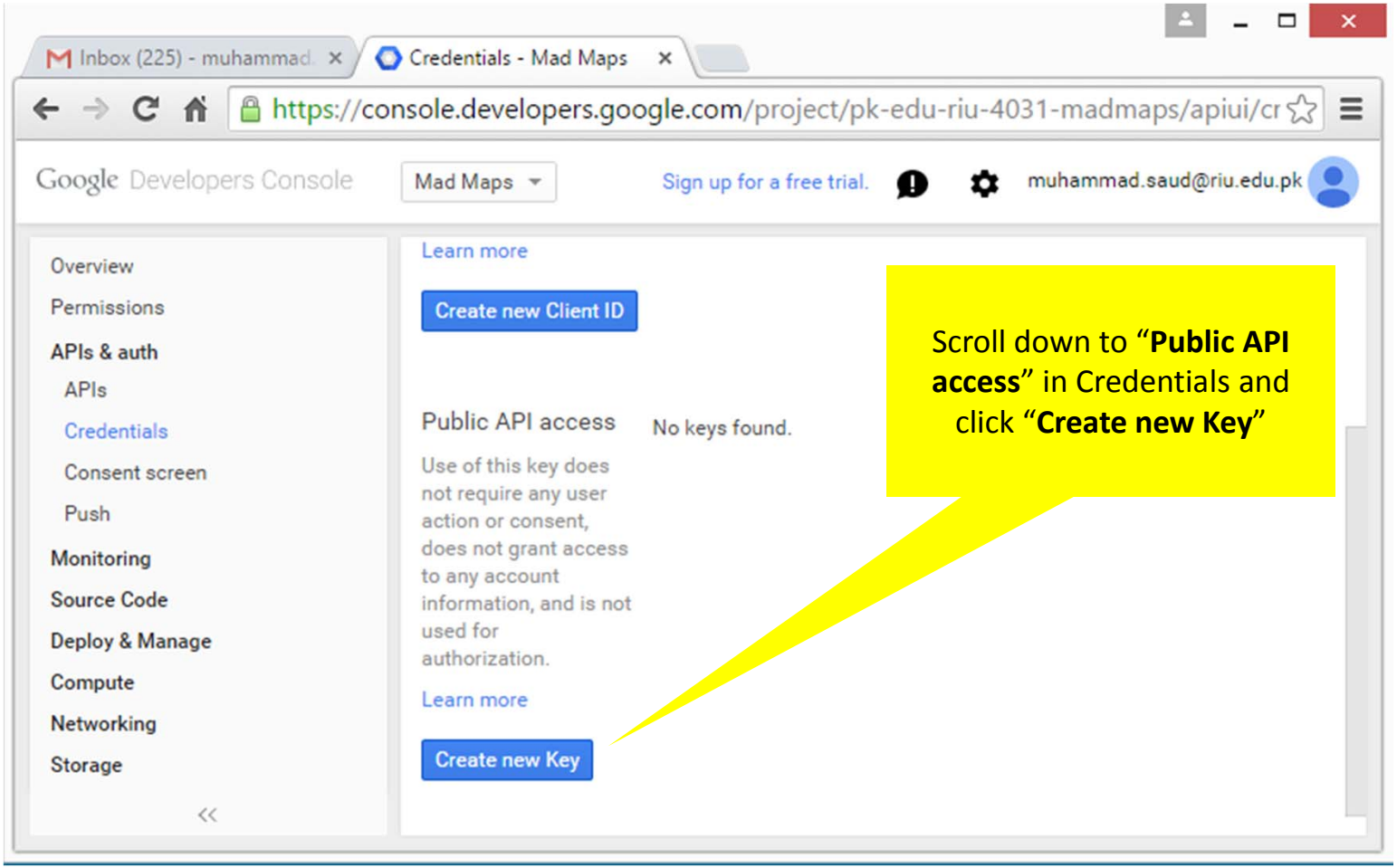
  - Go to the Google Developers Console: https://console.developers.google.com/

  - Select a project, or create a new one.

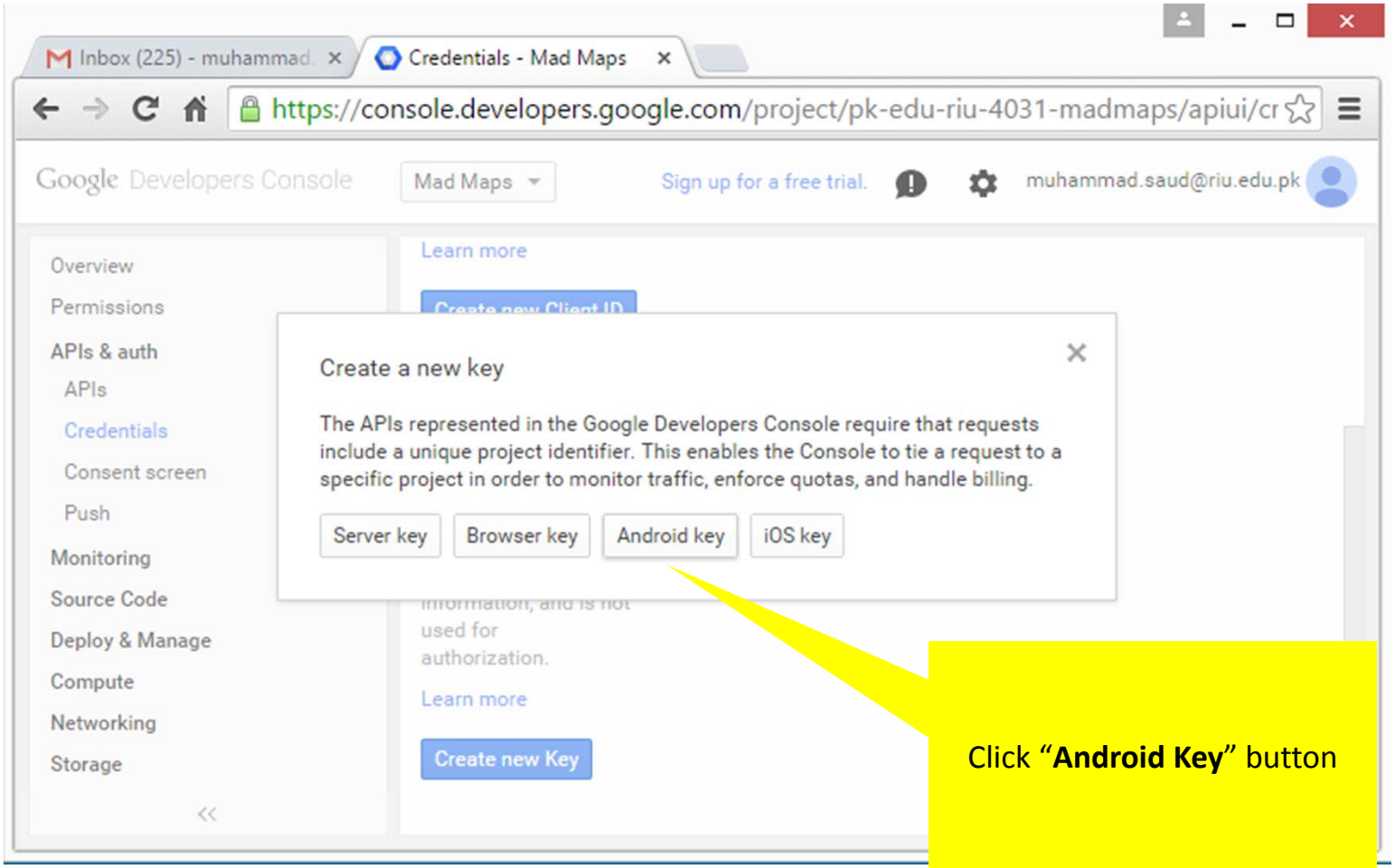
  - In the sidebar on the left, **expand APIs & auth**.
    - Next, **click APIs**.
    - Select the Enabled APIs link in the API section to see a list of all your enabled APIs. Make sure that the API is on the list of enabled APIs. If you have not enabled it, select the API from the list of APIs, then select the **Enable API button for the API**.
    - The only API you need is the Google Maps Android API, although you can choose to enable other APIs for the same project too.

  - In the sidebar on the left, **select Credentials**.

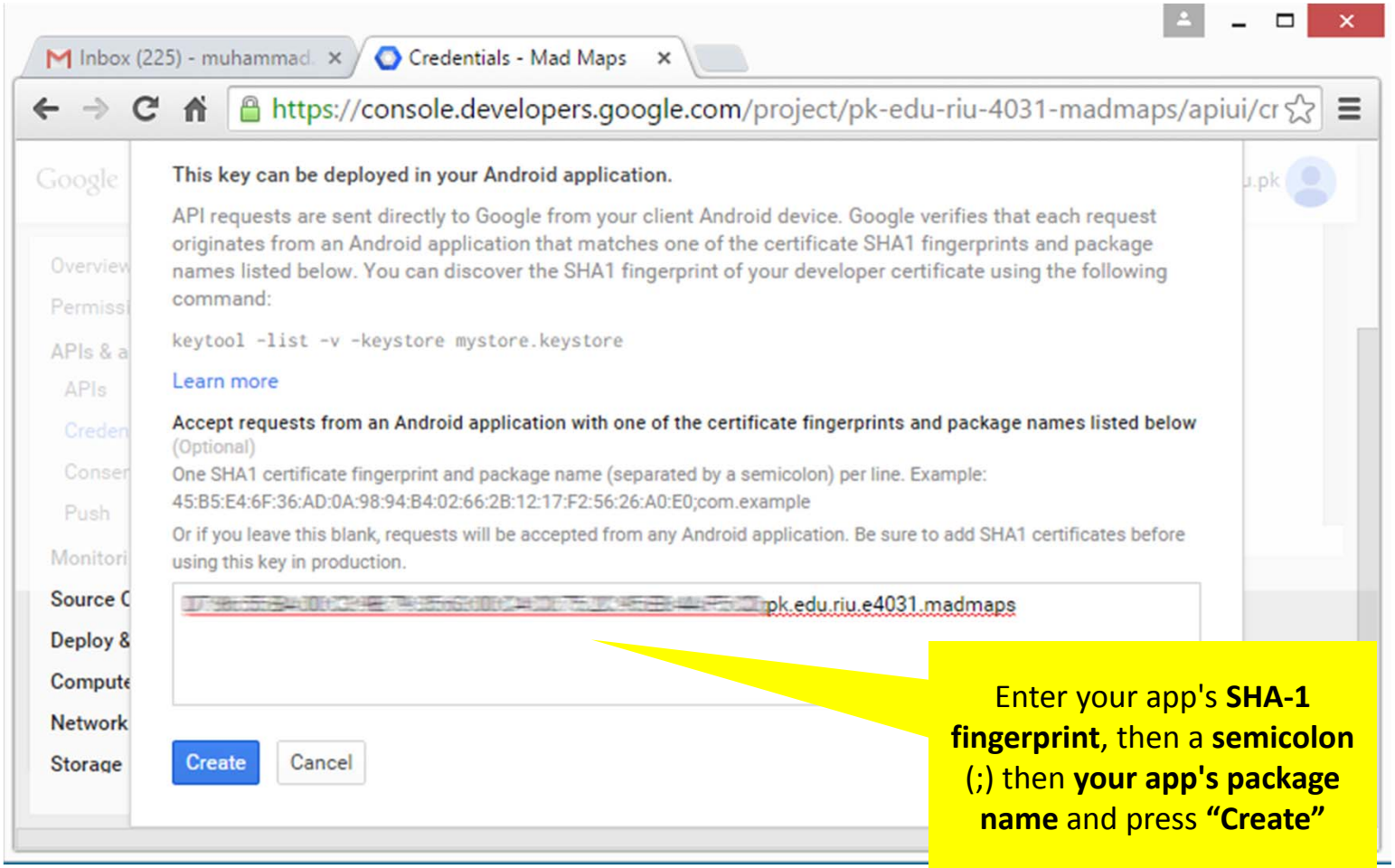
Google Developers Console



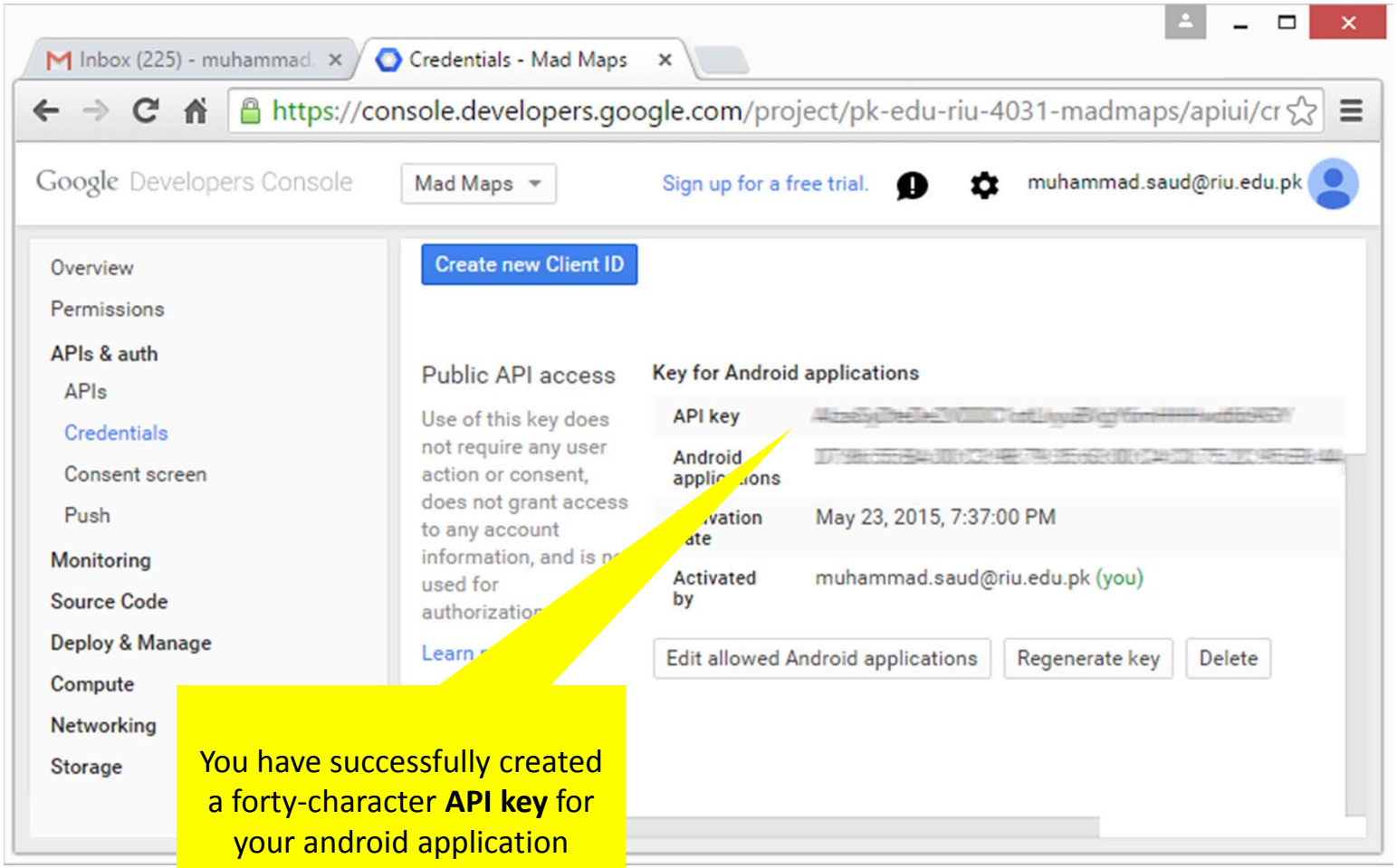
Google Developers Console



Google Developers Console



Google Developers Console



Google Developers Console

- Follow these steps to create or modify a project for your application in the Google Developers Console and enable the Google Maps Android API.


– Go to the Google Developers Console: https://console.developers.google.com/


– Select a project, or create a new one.


– In the sidebar on the left, **expand APIs & auth**.

  - Next, **click APIs**.
  - Select the Enabled APIs link in the API section to see a list of all your enabled APIs. Make sure that the API is on the list of enabled APIs. If you have not enabled it, select the API from the list of APIs, then select the **Enable API button for the API**.
  - The only API you need is the Google Maps Android API, although you can choose to enable other APIs for the same project too.


– In the sidebar on the left, **select Credentials**.

Create Your App

- Obtaining a Google Maps API Key for your application requires the following steps:
  - Retrieve information about your **Application's Certificate**. 
  - **Register a project in the Google Developers Console** and add the Maps API as a service for the project. 
  - **Request Google Maps API Key** for your project. 

Google Maps

- Set Up
  - Install **Google Play Services SDK** & **Google APIs** 
  - Create a **Virtual Device** that uses “Google APIs” Platform 
- Create Your App
  - Get an **App Certificate** and the **Google Maps API Key** 
  - **Add Google Play Services to Your Project**
  - Specify app settings in the **AndroidManifest.xml**
  - Add a **Map**

Add Google Play Services

- To make the Google Play services APIs available to your app:
  - Make sure your **minSdkVersion** is **17**
  - Open the **build.gradle (Module: app)** file inside your application module directory.
  - Add a **new build rule under dependencies** for the play-services.

```
dependencies {
    compile fileTree(dir: 'libs', include: ['*.jar'])
    compile 'com.android.support:appcompat-v7:22.1.1'
    compile 'com.google.android.gms:play-services-maps:6.5.87'
}
```

  - Save the changes and click **Sync Project** with Gradle Files.
  - You can now begin developing features with the Google Play services APIs.

Google Maps

- Set Up
  - Install **Google Play Services SDK** & **Google APIs** 
  - Create a **Virtual Device** that uses “Google APIs” Platform 
- Create Your App
  - Get an **App Certificate** and the **Google Maps API Key** 
  - **Add Google Play Services to Your Project** 
  - Specify app settings in the **AndroidManifest.xml**
  - Add a **Map**

AndroidManifest.xml

- An Android application that uses the Google Maps Android API should specify the following settings in its manifest file, AndroidManifest.xml:
  - A reference to the Google Play services version.
  - The Maps API key for the application. The key confirms that you've registered with the Google Maps service via the Google Developers Console.
  - Permissions that give the application access to Android system features and to the Google Maps servers.
  - Notification that the application requires OpenGL ES version 2. External services can detect this notification and act accordingly. (Recommended)

AndroidManifest.xml

- **Add the Google Play Services Version**
  Add the following declaration within the <application> element. This **embeds the version of Google Play services** that the app was compiled with.

```
<meta-data
    android:name="com.google.android.gms.version"
    android:value="@integer/google_play_services_version" />
```

AndroidManifest.xml

- **Add the API Key**

  In AndroidManifest.xml, add the following element as a child of the <application> element, by inserting it just before the closing tag </application>:

```
<meta-data
    android:name="com.google.android.geo.API_KEY"
    android:value="YOUR_API_KEY"/>
```

  Substitute your API key for YOU_API_KEY in the value attribute. This element sets the key com.google.android.geo.API_KEY to the value of your API key, and makes the API key visible to any **MapFragment** in your application.

AndroidManifest.xml

- **Specify Permissions**
  Specify the permissions your application needs, by adding <uses-permission> elements as children of the <manifest> element:

```
<uses-permission android:name="android.permission.INTERNET"/>
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>
<uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE"/>
<!-- The following two permissions are not required to use
     Google Maps Android API v2, but are recommended. -->
<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/>
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
```

AndroidManifest.xml

- **Specify Requirement for OpenGL ES Version 2**
  The Google Maps Android API uses OpenGL ES version 2 to render the map. If OpenGL ES version 2 is not installed, your map will not appear.

  Google recommends that you add the following <uses-feature> element as a child of the <manifest> element in AndroidManifest.xml::

```
<uses-feature
        android:glEsVersion="0x00020000"
        android:required="true"/>
```

Google Maps

- Set Up
  - Install **Google Play Services SDK** & **Google APIs** 
  - Create a **Virtual Device** that uses “Google APIs” Platform 
- Create Your App
  - Get an **App Certificate** and the **Google Maps API Key** 
  - **Add Google Play Services to Your Project** 
  - Specify app settings in the **AndroidManifest.xml** 
  - Add a **Map**

Add Map

- The basic steps for adding a map are:
  - **Add a Fragment object** to the Activity that will handle the map. The easiest way to do this is to add a <fragment> element to the layout file for the Activity.
  - Implement the **OnMapReadyCallback** interface and use the **onMapReady(GoogleMap)** callback method to get a handle to the GoogleMap object. The GoogleMap object is the internal representation of the map itself. To set the view options for a map, you modify its **GoogleMap object**.
  - Call **getMapAsync()** on the fragment to register the callback.

Add Map

- **Add Fragment Object**

  Add a <fragment> element to the activity's layout file to define a Fragment object. In this element, set the android:name attribute to "com.google.android.gms.maps.MapFragment". This automatically attaches a MapFragment to the activity.

```
<fragment
    android:layout_width="match_parent"
    android:layout_height="0dp"
    android:layout_weight="1"
    android:name="com.google.android.gms.maps.MapFragment"
    android:id="@+id/map" />
```

Add Map

- **Add Map Code**
  To work with the map inside your app, you'll need to implement the **OnMapReadyCallback** interface and set an instance of the callback on a MapFragment.

```
public class MainActivity extends Activity implements OnMapReadyCallback {
...
     @Override
     protected void onCreate(Bundle savedInstanceState) {
             super.onCreate(savedInstanceState);
             setContentView(R.layout.activity_main);




     }
...
}
```

Add Map

- **Add Map Code**
  Get a handle to the fragment by calling **FragmentManager.findFragmentById()**, passing it the resource ID of your <fragment> element.

```
public class MainActivity extends Activity implements OnMapReadyCallback {
...
     @Override
     protected void onCreate(Bundle savedInstanceState) {
              super.onCreate(savedInstanceState);
              setContentView(R.layout.activity_main);

              MapFragment mapFragment= (MapFragment)
                       getFragmentManager().findFragmentById(R.id.map);

              mapFragment.getMapAsync(this);
     }
...
}
```

Add Map

- **Add Map Code**
  Use the **onMapReady(GoogleMap)** callback method to get a handle to the GoogleMap object. The callback is triggered when the map is ready to be used. You can use the GoogleMap object to set various options for the map.

```
public class MainActivity extends Activity implements OnMapReadyCallback {
...
    @Override
    public void onMapReady(GoogleMap googleMap) {



    }
...
}
```

Add Map

- **Add Map Code**
  Use the **onMapReady(GoogleMap)** callback method to get a handle to the GoogleMap object. The callback is triggered when the map is ready to be used. You can use the GoogleMap object to set various options for the map.

```
public class MainActivity extends Activity implements OnMapReadyCallback {
...
    @Override
    public void onMapReady(GoogleMap googleMap) {
            googleMap.addMarker(new MarkerOptions()
                    .position(new LatLng(33.6667, 73.1667))
                    .title("Main Campus"));
    }
...
}
```

Google Maps

- Set Up
  - Install **Google Play Services SDK** & **Google APIs** 
  - Create a **Virtual Device** that uses “Google APIs” Platform 
- Create Your App
  - Get an **App Certificate** and the **Google Maps API Key** 
  - **Add Google Play Services to Your Project** 
  - Specify app settings in the **AndroidManifest.xml** 
  - Add a **Map** 

GOOGLE MAP OBJECT

GoogleMap Object

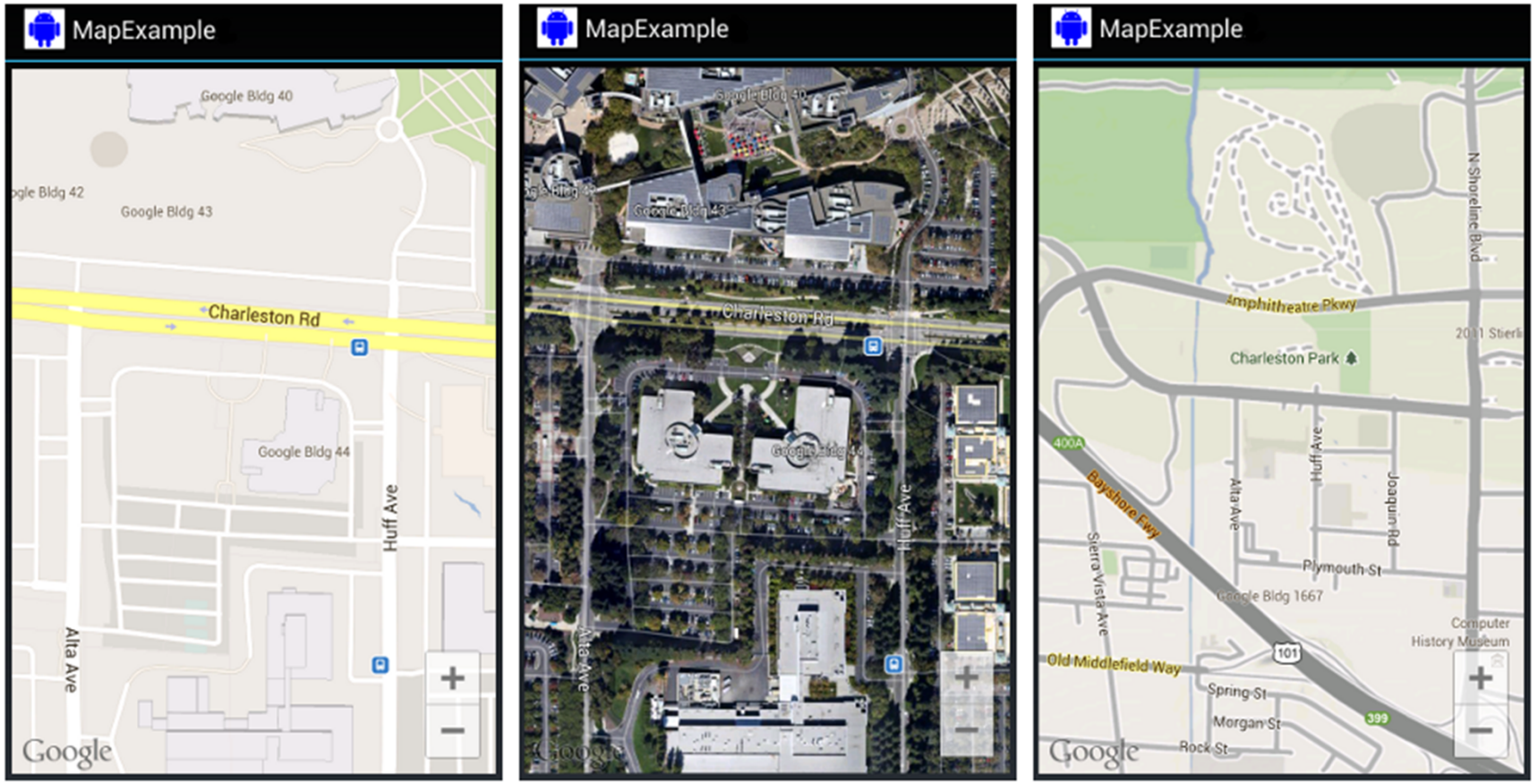
- The key class when working with a map object is the GoogleMap class. GoogleMap models the map object within your application. GoogleMap handles the following operations automatically:
  - Connecting to the Google Maps service.
  - Downloading map tiles.
  - Displaying tiles on the device screen.
  - Displaying various controls such as pan and zoom.
  - Responding to pan and zoom gestures by moving the map and zooming in or out.
- In addition to these automatic operations, you can control the behavior of maps with objects and methods of the API.

Map Types

- The Google Maps Android API offers four types of maps, as well as an option to have no map at all:
  - **Normal:** Typical road map. Roads, some man-made features, and important natural features such as rivers are shown. Road and feature labels are also visible.
  - **Hybrid:** Satellite photograph data with road maps added. Road and feature labels are also visible.
  - **Satellite:** Satellite photograph data. Road and feature labels are not visible.
  - **Terrain:** Topographic data. The map includes colors, contour lines and labels, and perspective shading. Some roads and labels are also visible.
  - **None:** No tiles. The map will be rendered as an empty grid with no tiles loaded.

Map Types

Comparison of normal, hybrid and terrain maps



Map Types

- **Change the Map Type**

  To set the type of a map, call the GoogleMap object's **setMapType()** method, passing one of the type constants defined in GoogleMap.

```
public void onMapReady(GoogleMap googleMap) {
    googleMap.addMarker(new MarkerOptions()
            .position(new LatLng(33.6667, 73.1667))
            .title("Main Campus"));

    googleMap.setMapType(GoogleMap.MAP_TYPE_HYBRID);
}
```

Customizing Markers

- Markers indicate single locations on the map. You can customize your markers by changing the default color, or replacing the marker icon with a custom image.

```
public void onMapReady(GoogleMap googleMap) {
    googleMap.addMarker(new MarkerOptions()
            .position(new LatLng(33.6667, 73.1667))
            .title("Main Campus"));

}
```

Customizing Markers

- **Customize the Marker Color:**

```
public void onMapReady(GoogleMap googleMap) {
     googleMap.addMarker(new MarkerOptions()
             .position(new LatLng(33.6667, 73.1667))

             .icon(BitmapDescriptorFactory
                     .defaultMarker(BitmapDescriptorFactory
                             .HUE_BLUE))

             .title("Main Campus"));

 }
```

Customizing Markers

- **Customize the Marker Opacity:**

```
public void onMapReady(GoogleMap googleMap) {
     googleMap.addMarker(new MarkerOptions()
             .position(new LatLng(33.6667, 73.1667))

             .alpha(0.5f)

             .title("Main Campus"));

 }
```

Customizing Markers

- **Customize the Marker Image:**

```
public void onMapReady(GoogleMap googleMap) {
     googleMap.addMarker(new MarkerOptions()
             .position(new LatLng(33.6667, 73.1667))

             .icon(BitmapDescriptorFactory
                     .fromResource(R.drawable.arrow))

             .title("Main Campus"));

 }
```

Configure Initial State

- The Maps API allows you to configure the initial state of the map to suit your application's needs. For example you can specify:
  - **The camera position**, including: location, zoom, bearing and tilt.
  - **The map type**.
  - Whether the **zoom buttons and/or compass** appear on screen.
  - The **gestures** a user can use to manipulate the camera.

Configure Initial State

- The Maps API defines a set of custom XML attributes for a MapFragment that you can use to configure the initial state of the map directly from the layout file.
  - **mapType.** This allows you to specify the type of map to display. Valid values include: none, normal, hybrid, satellite and terrain.
  - **cameraTargetLat, cameraTargetLng, cameraZoom, cameraBearing, cameraTilt**. These allow you to specify the initial camera position.
  - **uiZoomControls, uiCompass.** These allow you to specify whether you want the zoom controls and compass to appear on the map.
  - **uiZoomGestures, uiScrollGestures, uiRotateGestures, uiTiltGestures**. These allow you to specify which gestures are enabled/disabled for interaction with the map.

Configure Initial State

- In order to use these custom attributes within your XML layout file, **you must first add the following namespace declaration**. You can choose any namespace, it doesn't have to be map:

```
xmlns:map="http://schemas.android.com/apk/res-auto"
```

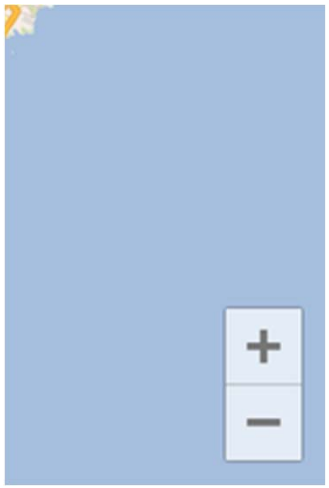
- You can then add the attributes with a **map: prefix** into your layout components, as you would with standard Android attributes.

Configure Initial State

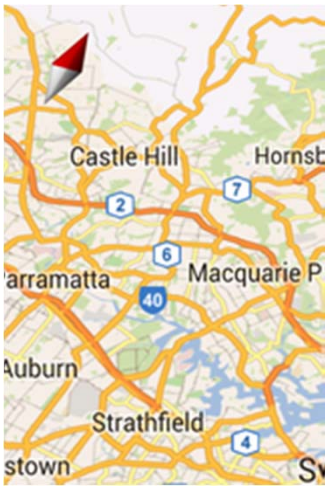
```
<fragment xmlns:android="http://schemas.android.com/apk/res/android"
  xmlns:map="http://schemas.android.com/apk/res-auto"
  android:name="com.google.android.gms.maps.SupportMapFragment"
  android:id="@+id/map"
  android:layout_width="match_parent"
  android:layout_height="match_parent"
  map:cameraBearing="0"
  map:cameraTargetLat="33.6667"
  map:cameraTargetLng="73.1667"
  map:cameraTilt="30"
  map:cameraZoom="5"
  map:mapType="normal"
  map:uiCompass="false"
  map:uiRotateGestures="true"
  map:uiScrollGestures="false"
  map:uiTiltGestures="true"
  map:uiZoomControls="false"
  map:uiZoomGestures="true" />
```

Interactively Changing UI Controls

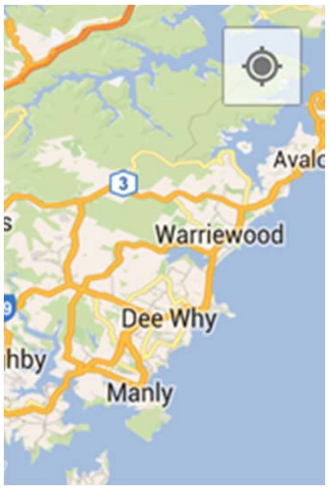
ZoomControls



Compass



MyLocation



MapToolbar

Interactively Changing UI Controls

- You can toggle the visibility of various controls in your map using the **UiSettings class** which can be obtained from a GoogleMap with the **GoogleMap.getUiSettings** method:

```
MapFragment mapFragment;
. . .
public void someMethod (View v) {
    GoogleMap gMap=mapFragment.getMap();

    gMap.getUiSettings().setZoomControlsEnabled(true);

}
```

Interactively Changing UI Controls

- You can toggle the visibility of various controls in your map using the **UiSettings class** which can be obtained from a GoogleMap with the **GoogleMap.getUiSettings** method:
  - `UiSettings.setZoomControlsEnabled(boolean)`
  - `UiSettings.setCompassEnabled(boolean)`
  - `UiSettings.setMyLocationButtonEnabled(boolean)`
  - `UiSettings.setMapToolbarEnabled(boolean)`
  - `UiSettings.setZoomGesturesEnabled(boolean)`
  - `UiSettings.setScrollGesturesEnabled(boolean)`
  - `UiSettings.setTiltGesturesEnabled(boolean)`
  - `UiSettings.setRotateGesturesEnabled(boolean)`

Map Events

- If you want to respond to a user tapping on a point on the map, you can use an **OnMapClickListener** which you can set on the map by calling **GoogleMap.setOnMapClickListener(OnMapClickListener)**.

- When a user clicks (taps) somewhere on the map, you will receive an **onMapClick(LatLng)** event that indicates the location on the map that the user clicked.

Map Events

- You can also listen for long click events with an **OnMapLongClickListener** which you can set on the map by calling **GoogleMap.setOnMapLongClickListener(OnMapLongClickListener)**.

- This listener behaves similarly to the click listener and will be notified on long click events with an **onMapLongClick(LatLng)** callback.

Map Events

```
public void onMapReady(GoogleMap googleMap) {
    . . .
    googleMap.setOnMapClickListener(new GoogleMap.OnMapClickListener() {
          @Override
          public void onMapClick(LatLng latLng) {

               String location = String.valueOf(latLng.latitude)
                         + ", " +String.valueOf(latLng.longitude);

               Toast.makeText(getApplicationContext(),
                         "Your Location: " +
                         location,Toast.LENGTH_SHORT).show();
          }
    });
}
```

Camera

- The map view is modeled as a camera looking down on a flat plane.
- The position of the camera (and hence the rendering of the map) is specified by the following properties: target (latitude/longitude location), zoom, bearing and tilt.

Camera

```
MapFragment mapFragment;
private static final LatLng A = new LatLng(33.616492, 72.971892);
private static final LatLng B = new LatLng(33.5980297, 73.0414803);
private static final LatLng C = new LatLng(33.7332804,73.0884844);
. . .
public void gotoC (View v) {
        GoogleMap gMap=mapFragment.getMap();

        CameraPosition cameraPosition = new CameraPosition.Builder()
                .target(C)
                .zoom(15)
                .bearing(90)
                .tilt(30)
                .build();

        gMap.animateCamera(CameraUpdateFactory
                .newCameraPosition(cameraPosition));
}
```

Camera

```
MapFragment mapFragment;
private static final LatLng A = new LatLng(33.616492, 72.971892);
private static final LatLng B = new LatLng(33.5980297, 73.0414803);
private static final LatLng C = new LatLng(33.7332804,73.0884844);
. . .
public void gotoC (View v) {
        GoogleMap gMap=mapFragment.getMap();

        CameraPosition cameraPosition = new CameraPosition.Builder()
                .target(B)
                .zoom(15)
                .build();

        gMap.moveCamera(CameraUpdateFactory
                .newCameraPosition(cameraPosition));
}
```

References

- https://developers.google.com/maps/documentation/android/start
- http://developer.android.com/google/play-services/maps.html
- http://docs.oracle.com/javase/6/docs/technotes/tools/windows/keytool.html
- https://developer.android.com/google/play-services/setup.html
- http://stackoverflow.com/questions/29425015/this-app-wont-run-unless-you-update-google-play-services-when-app-is-installe
- https://developer.android.com/tools/publishing/app-signing.html
- https://developer.android.com/reference/com/google/android/gms/maps/MapFragment.html
- https://developer.android.com/training/location/index.html
- https://developers.google.com/console/help/new/#apikeybestpractices

Q & A