



# Homework 1

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Game Graphics  
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siamiz@khu.ac.kr

# Goal

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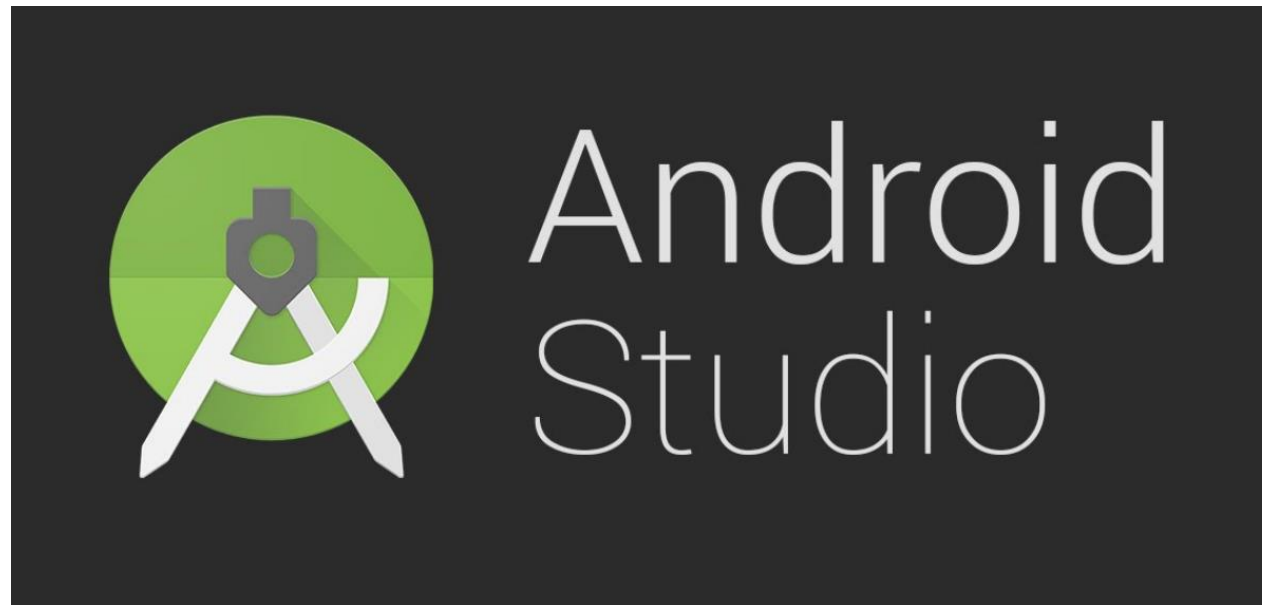


- Setting up Android Studio development environment
- Filling in code lines in the vertex shader.
  - Vertex position
  - Vertex normal
  - Texture coordinates
- Filling in code lines in the functions of the scene class in GL program.
- +10 points homework.

# Android Studio



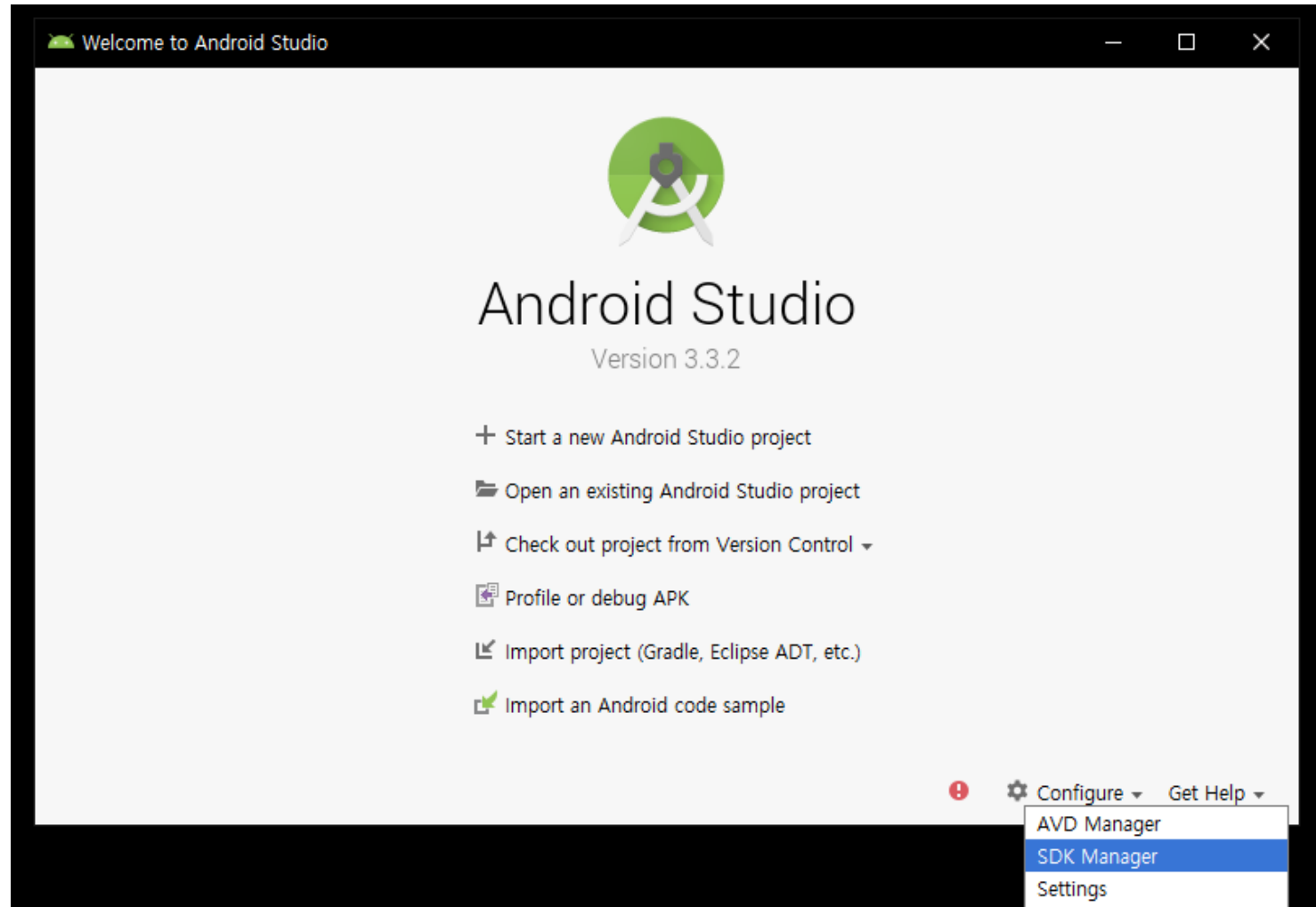
- **Android Studio** is the official integrated development environment (IDE) for the Android platform.
- Android Studio can be downloaded from the official website.



# Android SDK



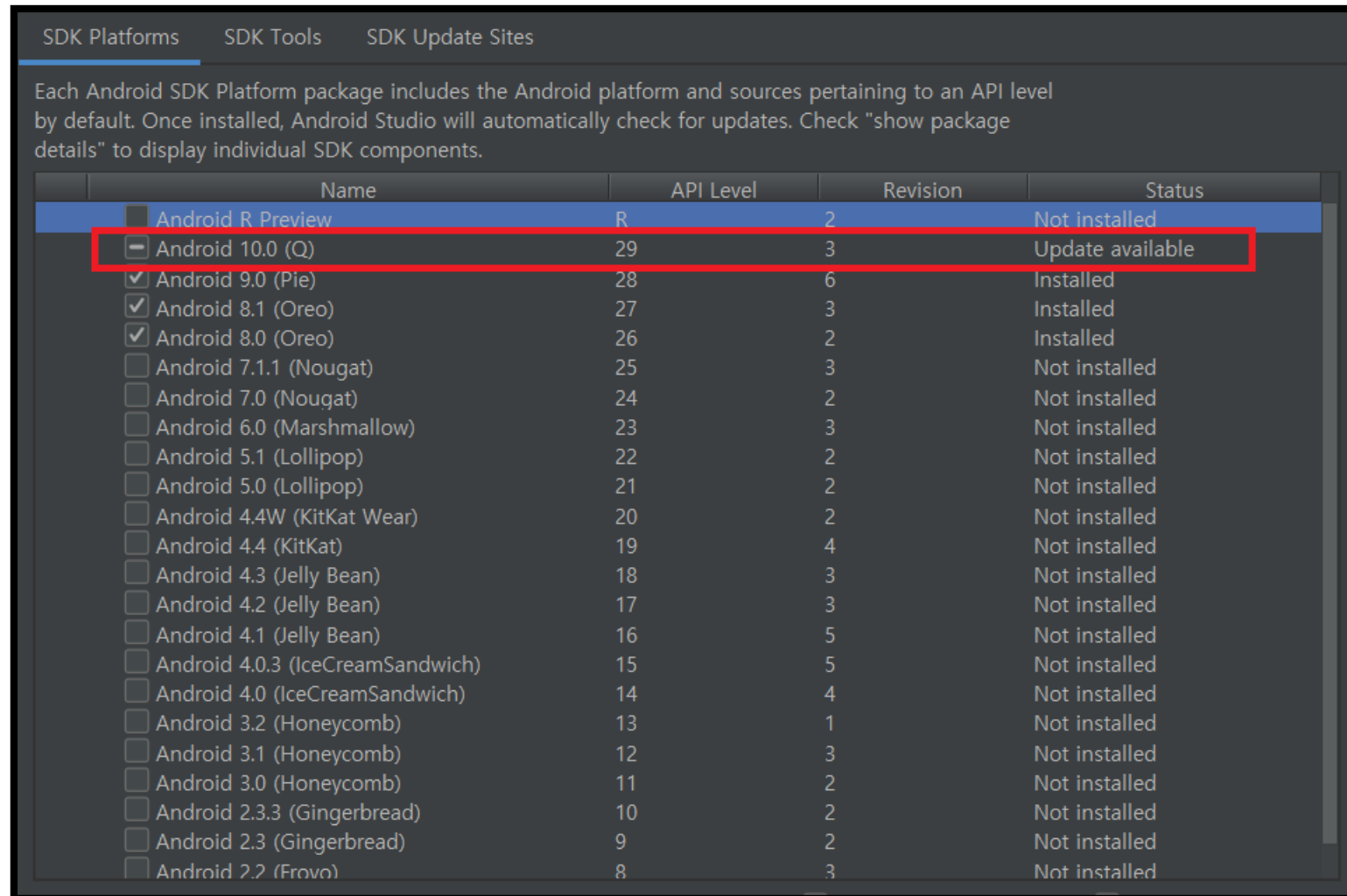
- **Android SDK** can be installed through the SDK Manager in Android Studio.



# Android SDK



- The **latest platform** (2020.03.26. Android 10.0 Q) will be installed automatically.

A screenshot of the Android Studio SDK Manager window. The 'SDK Platforms' tab is selected. A red rectangle highlights the row for 'Android 10.0 (Q)', which shows 'Update available'. The table lists various Android versions from 2.2 to R Preview, with their API levels and revision numbers. The status of each platform is indicated in the 'Status' column.

	Name	API Level	Revision	Status
<input type="checkbox"/>	Android R Preview	R	2	Not installed
<input type="checkbox"/>	Android 10.0 (Q)	29	3	Update available
<input checked="" type="checkbox"/>	Android 9.0 (Pie)	28	6	Installed
<input checked="" type="checkbox"/>	Android 8.1 (Oreo)	27	3	Installed
<input checked="" type="checkbox"/>	Android 8.0 (Oreo)	26	2	Installed
<input type="checkbox"/>	Android 7.1.1 (Nougat)	25	3	Not installed
<input type="checkbox"/>	Android 7.0 (Nougat)	24	2	Not installed
<input type="checkbox"/>	Android 6.0 (Marshmallow)	23	3	Not installed
<input type="checkbox"/>	Android 5.1 (Lollipop)	22	2	Not installed
<input type="checkbox"/>	Android 5.0 (Lollipop)	21	2	Not installed
<input type="checkbox"/>	Android 4.4W (KitKat Wear)	20	2	Not installed
<input type="checkbox"/>	Android 4.4 (KitKat)	19	4	Not installed
<input type="checkbox"/>	Android 4.3 (Jelly Bean)	18	3	Not installed
<input type="checkbox"/>	Android 4.2 (Jelly Bean)	17	3	Not installed
<input type="checkbox"/>	Android 4.1 (Jelly Bean)	16	5	Not installed
<input type="checkbox"/>	Android 4.0.3 (IceCreamSandwich)	15	5	Not installed
<input type="checkbox"/>	Android 4.0 (IceCreamSandwich)	14	4	Not installed
<input type="checkbox"/>	Android 3.2 (Honeycomb)	13	1	Not installed
<input type="checkbox"/>	Android 3.1 (Honeycomb)	12	3	Not installed
<input type="checkbox"/>	Android 3.0 (Honeycomb)	11	2	Not installed
<input type="checkbox"/>	Android 2.3.3 (Gingerbread)	10	2	Not installed
<input type="checkbox"/>	Android 2.3 (Gingerbread)	9	2	Not installed
<input type="checkbox"/>	Android 2.2 (Froyo)	8	3	Not installed

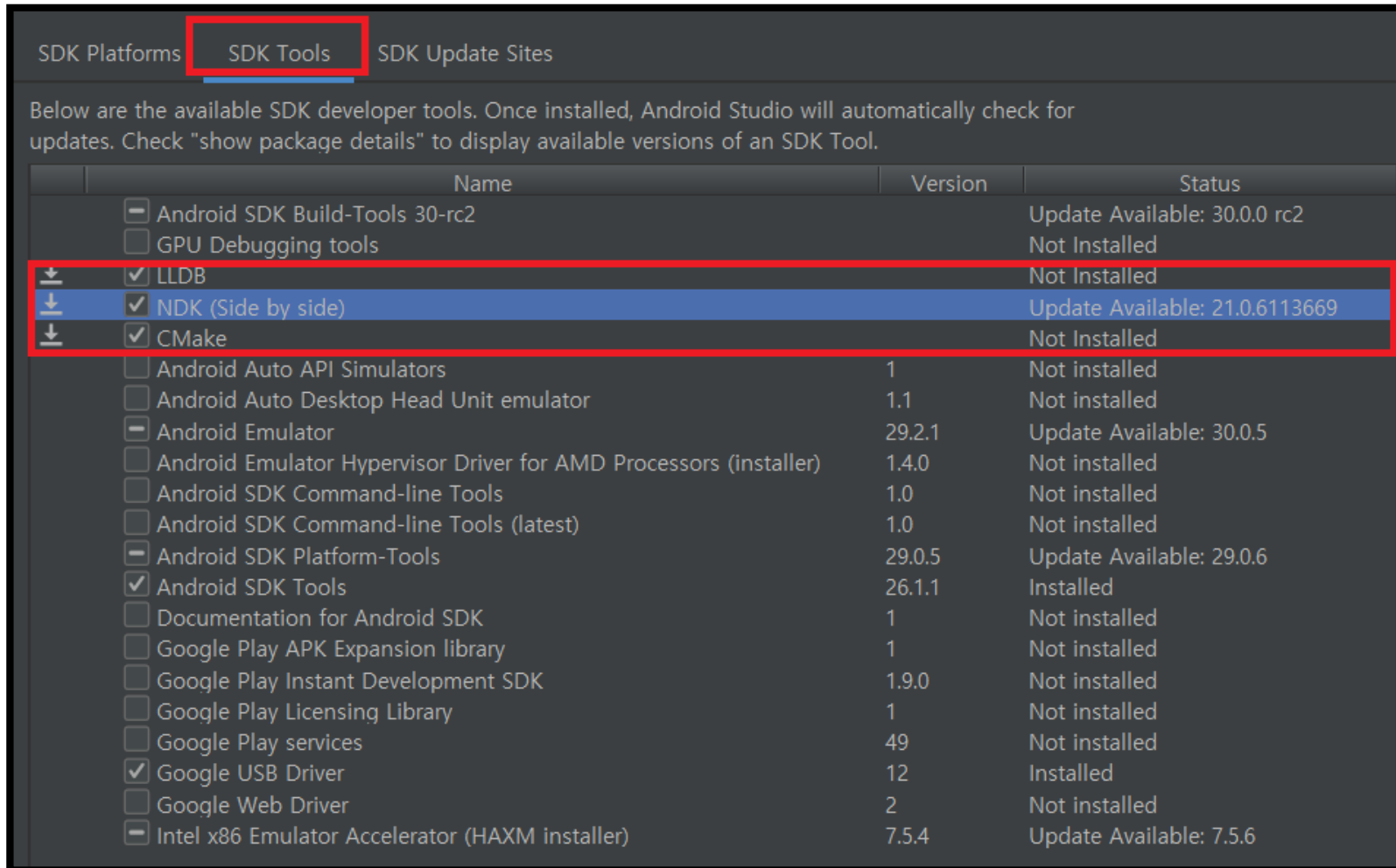
The image and the actual screen can be different.

# Android SDK



To use C++ native language on Android, you need to install the following three tools.

- CMake
- LLDB
- NDK

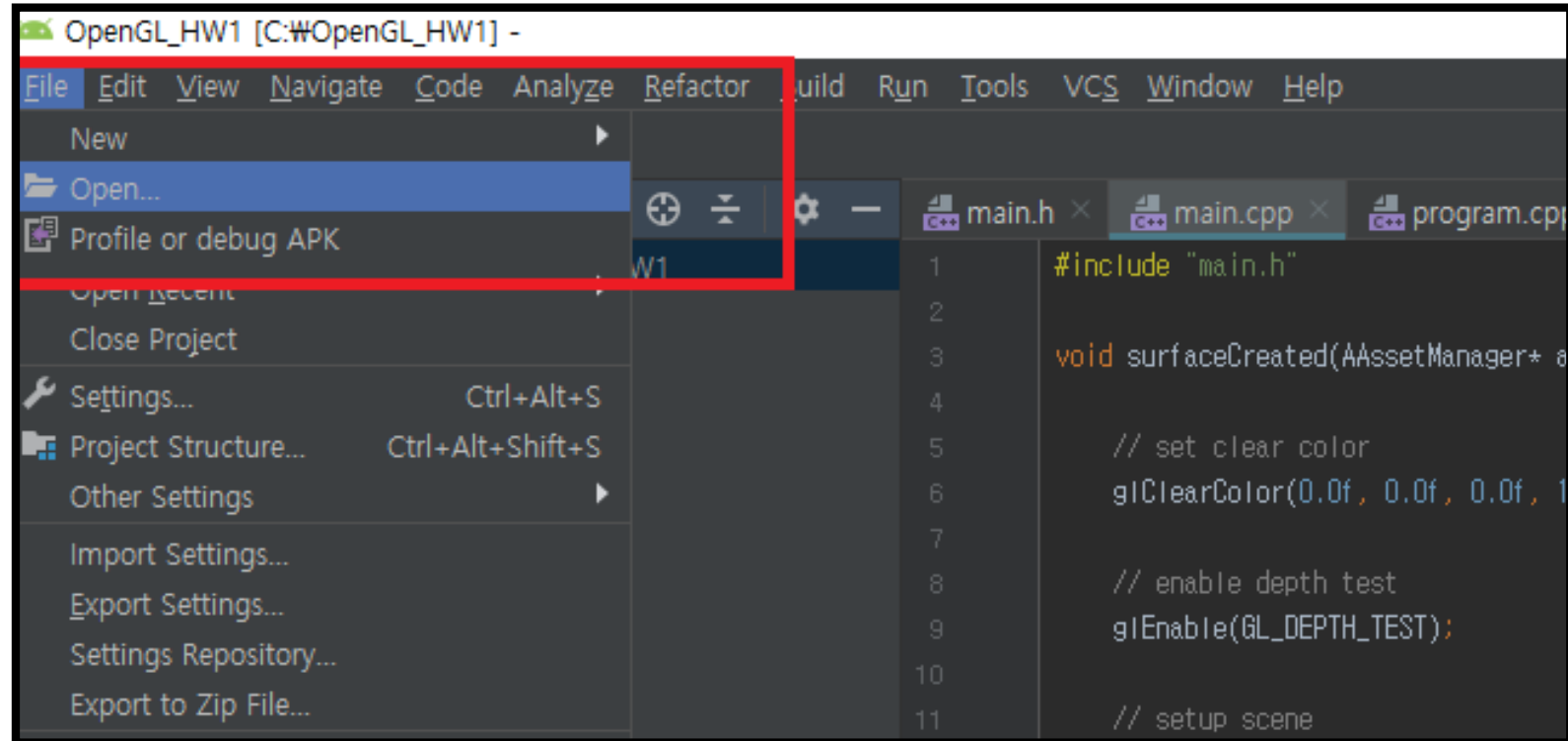


The image and the actual screen can be different.

# Open Project Folder



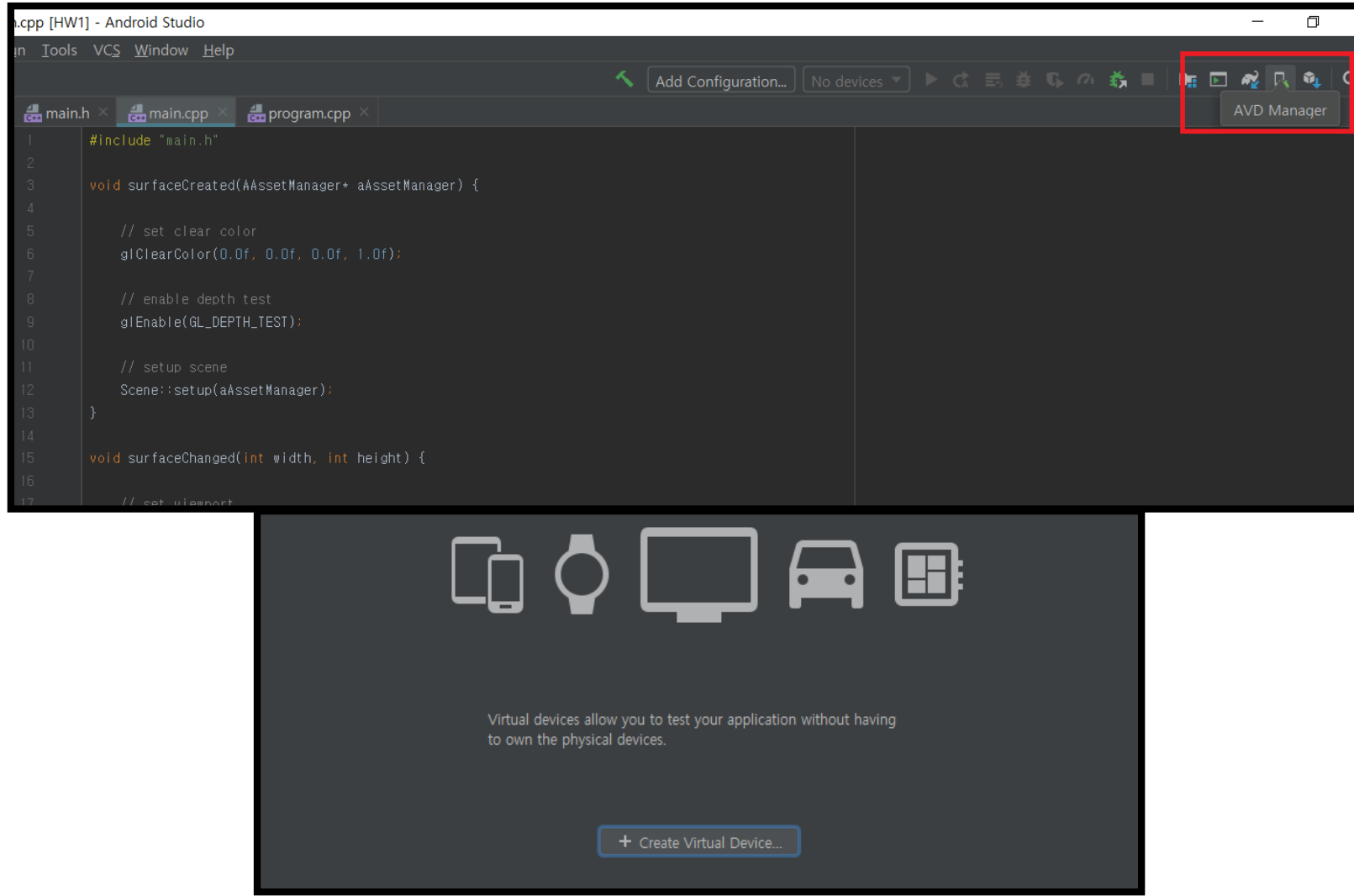
Click the [File] – [Open].



# Create Virtual Device



- After opening the project, let's create virtual device.
- Click the AVD Manager and create virtual device.



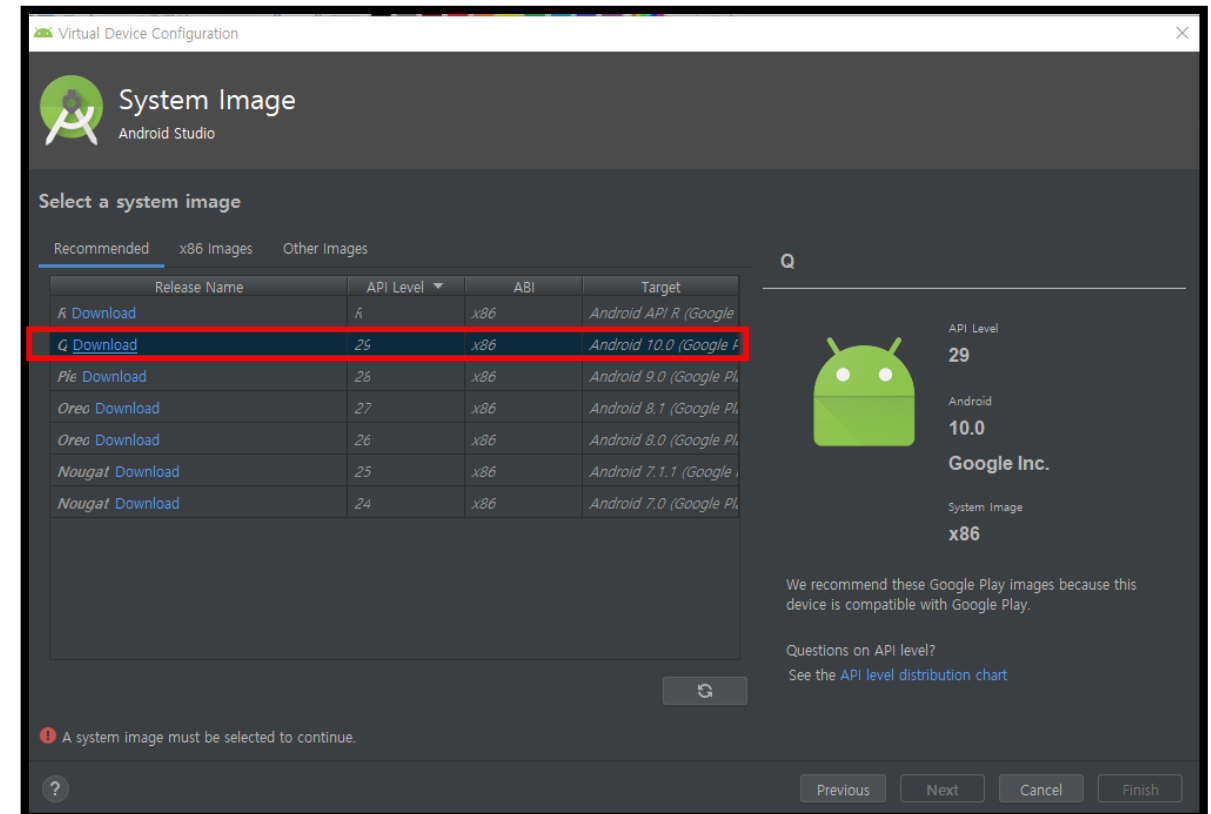
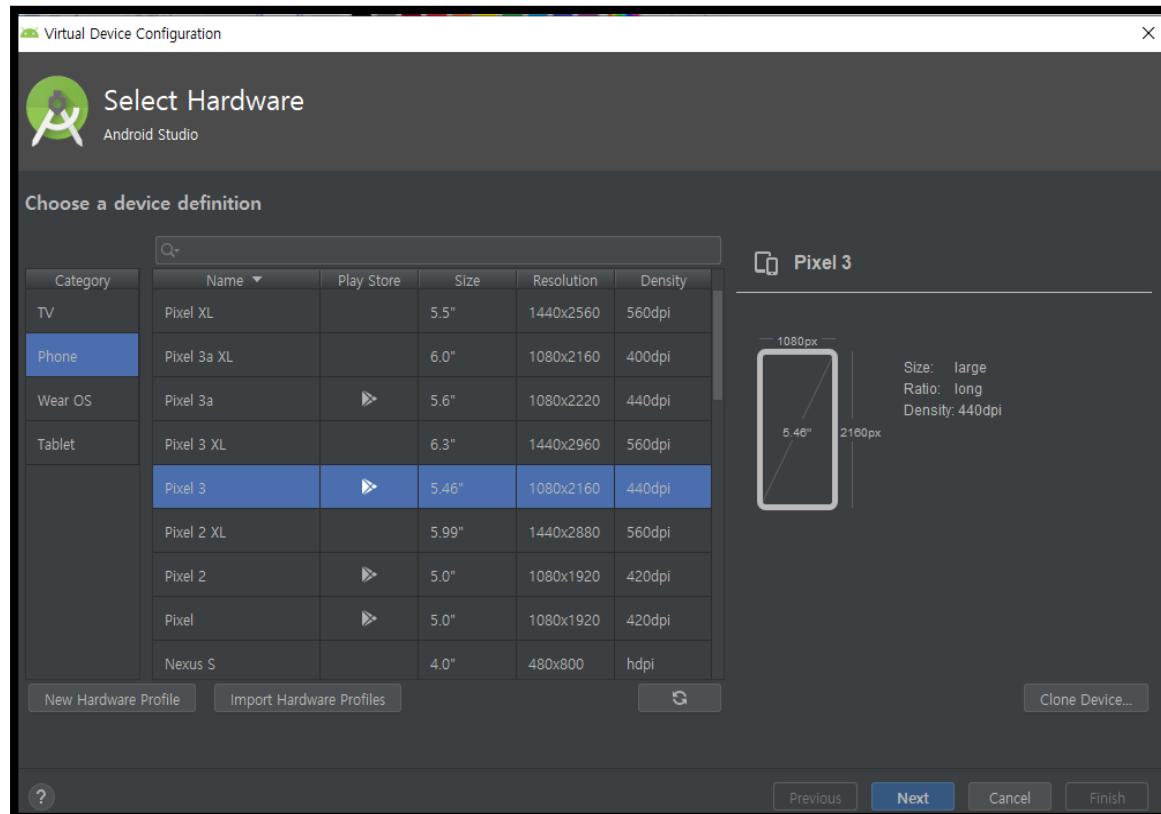


# Create Virtual Device



Choose the device you prefer. (In my case, Pixel 3 with system Q.)

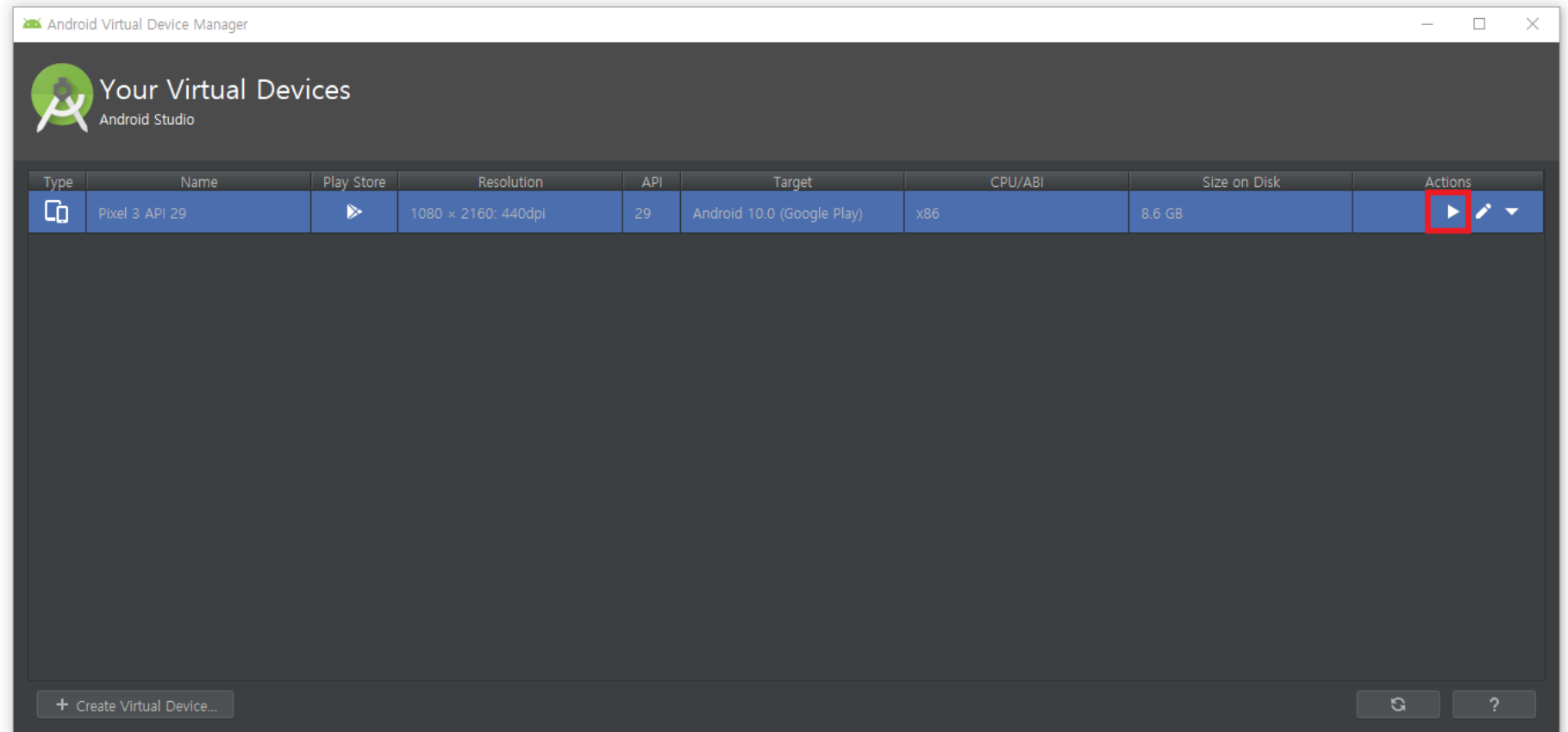
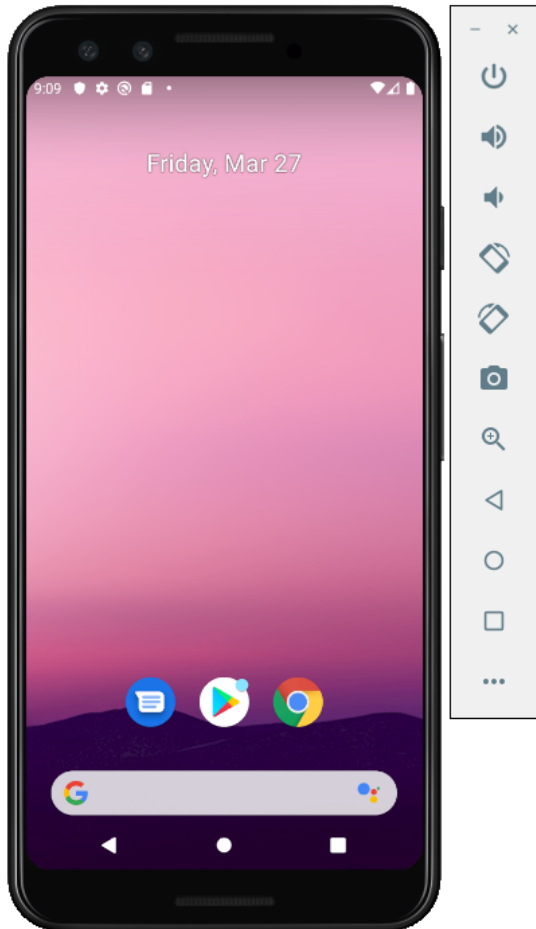
- If required, download the API.



# Create Virtual Device



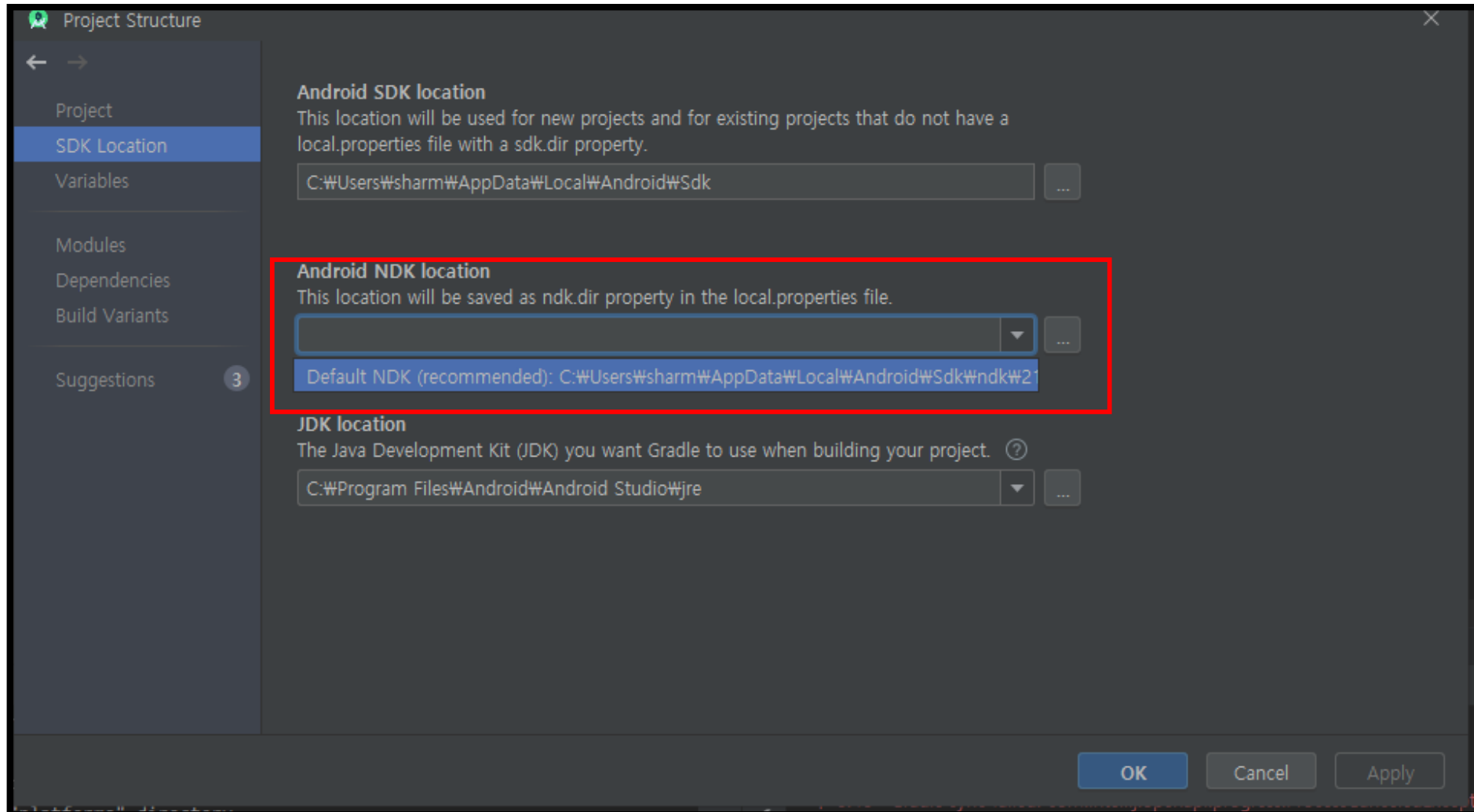
After finishing the creation, click the launch button on the Actions tab. Then, the virtual device shown on the left will appear.



# NDK Location



If the Android NDK location is empty, enter the location.



# Ready?



Then click the [Run] – [Run] (or green triangle shown below.)

- If required, several installation process will be performed (It takes several minutes.)

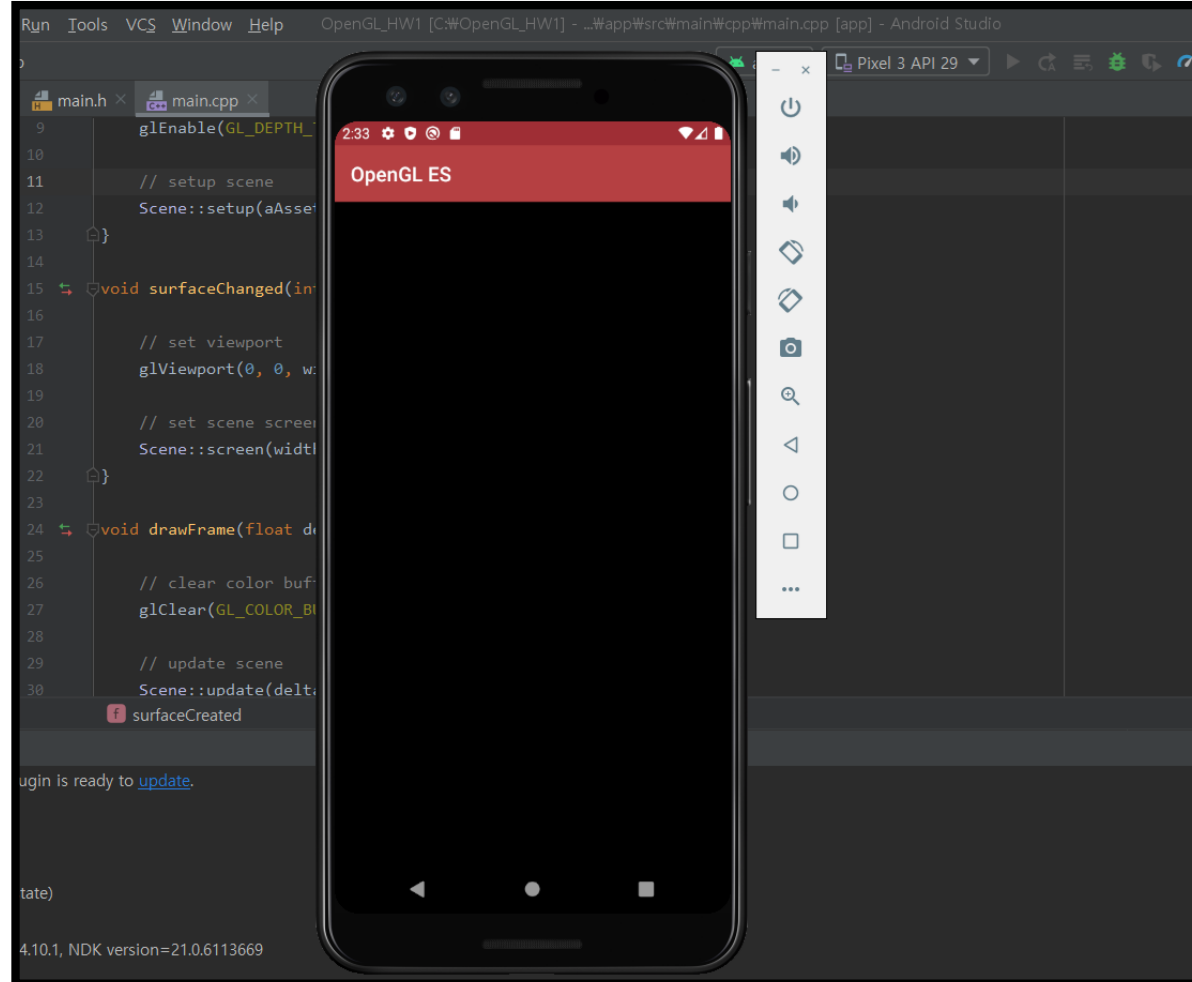
```
Run  Tools  VCS  Window  Help  OpenGL_HW1 [C:\OpenGL_HW1] - ...Wapp\src\main\cpp\main.cpp [app] - Android Studio

main.h x  main.cpp x
9      glEnable(GL_DEPTH_TEST);
10
11     // setup scene
12     Scene::setup(aAssetManager);
13 }
14
15 void surfaceChanged(int width, int height) {
16
17     // set viewport
18     glViewport(0, 0, width, height);
19
20     // set scene screen
21     Scene::screen(width, height);
22 }
23
24 void drawFrame(float deltaTime) {
25
26     // clear color buffer and depth buffer
27     glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
28
29     // update scene
30     Scene::update(deltaTime);
31 }
32
33 surfaceCreated
```

# Ready?



The emulator shown bellow will appear. Now, you are ready.



# Problem



Fill in lines.

- App/src/main/cpp/scene.cpp (setup and update)
- App/src/main/assets/vertex.glsl (main)

```
camera->eye = vec3(60.0f, 00.0f, 0.0f);

// create light
light = new Light(program);
light->position = vec3(100.0f, 0.0f, 0.0f);

// create floral texture
flower = new Material(program, texFlowerData, texFlowerSize);

// create teapot object
teapot = new Object(program, flower, objTeapotVertices, objTeapotIndices,
                    objTeapotVerticesSize, objTeapotIndicesSize);
//Set world matrix
//teapot->worldMatrix;

void Scene::screen(int width, int height) {

    // set camera aspect ratio
    camera->aspect = (float) width / height;
}
```

```
void Scene::update(float deltaTime) {
    static float angle = 0.0f;

    // use program
    program->use();

    // rotate the camera relative to the object
    // camera->eye = ;

    // setup camera and light
    camera->setup();
    light->setup();

    // draw teapot
    teapot->draw();
}
```

```
uniform vec3 lightPos;

layout(location = 0) in vec3 position;
layout(location = 1) in vec3 normal;
layout(location = 2) in vec2 texCoord;

out vec3 v_normal;
out vec2 v_texCoord;
out vec3 v_lightDir;

void main() {

    // fill in the lines below
    //gl_Position = ;
    //v_normal = ;
    //v_texCoord = ;

    // do not touch below
    vec3 posWS = (worldMat * vec4(position, 1.0)).xyz;
    v_lightDir = normalize(lightPos - posWS);
}
```

# Problem

Do not use rotate() function!



Goal 1 (3points). Write your code at the setup() to transform the teapot as follows:

- Scale the teapot by 1.0, 2.0 and 0.5 along the x, y and z axis respectively.
- Rotate the teapot by  $50^\circ$  around the axis, (1, 1, 0).

Goal 2 (3points). Write your code at the update() to rotate the camera around the y-axis

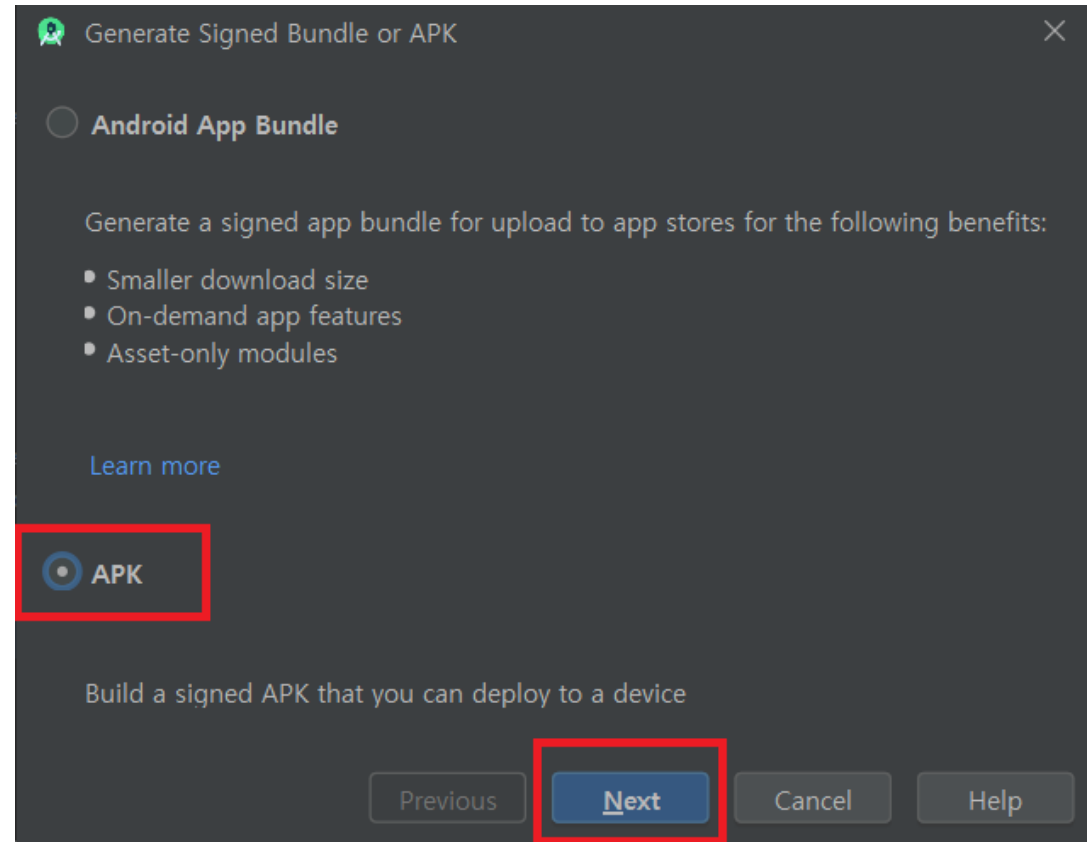
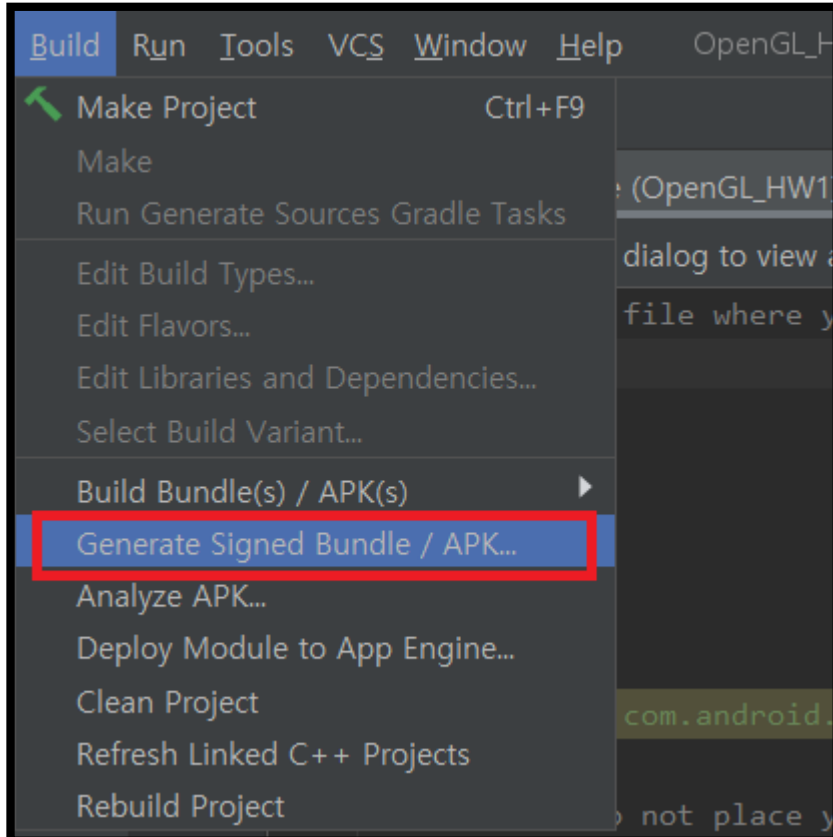
- Rotate the teapot by  $2^\circ$  for every update.

Goal 3 (4points). Write your code at the .glsl main().

- The clip-space vertex position must be calculated.
- The world-space vertex normal must be calculated accurately considering a non-uniform scaling (note that the lighting will look weird if vertex normals are incorrect.)
- The texture coordinates will be sent to the rasterizer stage with no change.



# Generate APK





# Generate APK



Generate Signed Bundle or APK

Module: app

Key store path:

Key store password:

Key alias:

Key password:

☐ Remember passwords

New Key Store

Key store path: C:\Users\sharm\HW1Key.jks

Password:  Confirm:

Key:

Alias: key0

Password:  Confirm:

Validity (years): 25

Certificate

First and Last Name: Siamiz

Organizational Unit:

Organization:

City or Locality:

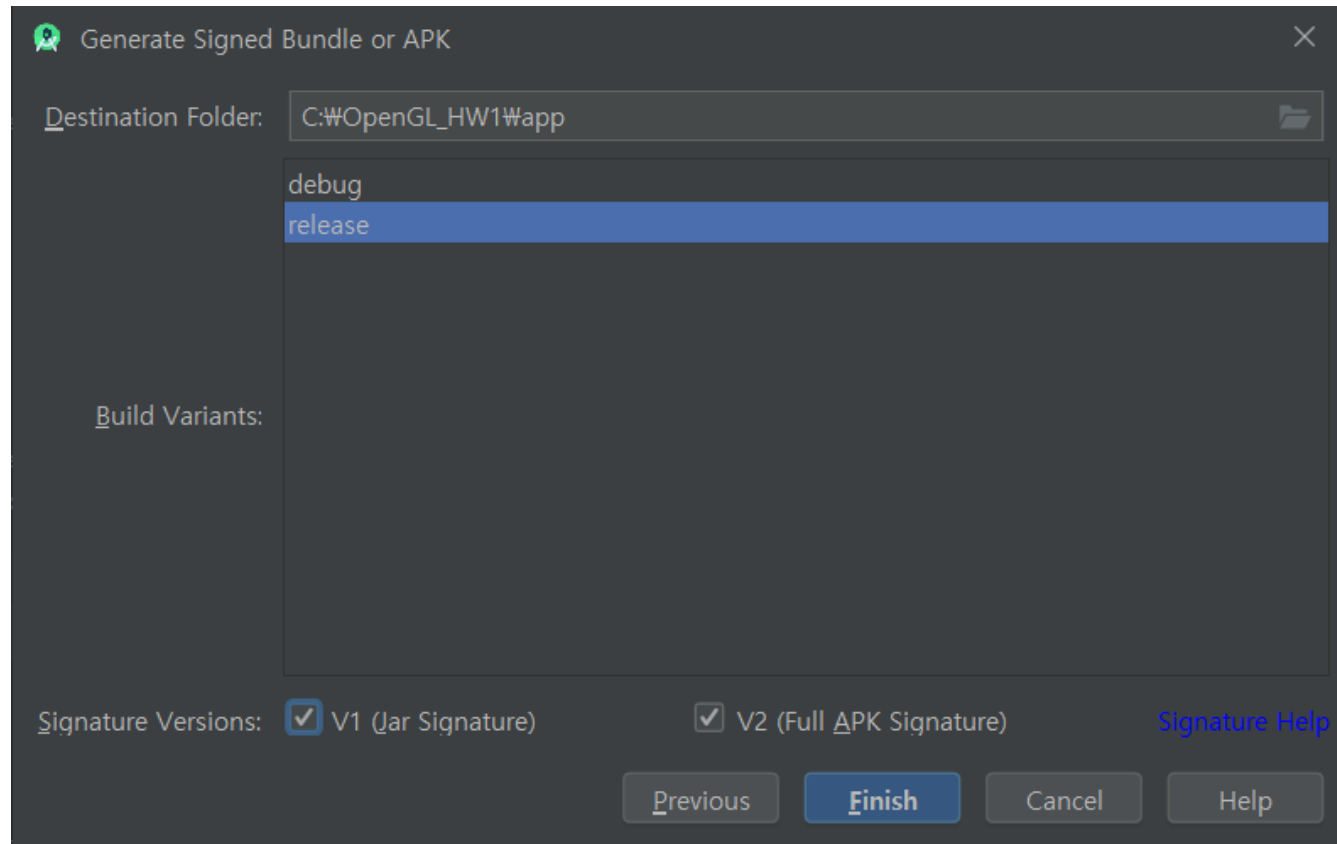
State or Province:

Country Code (XX):

# Generate APK



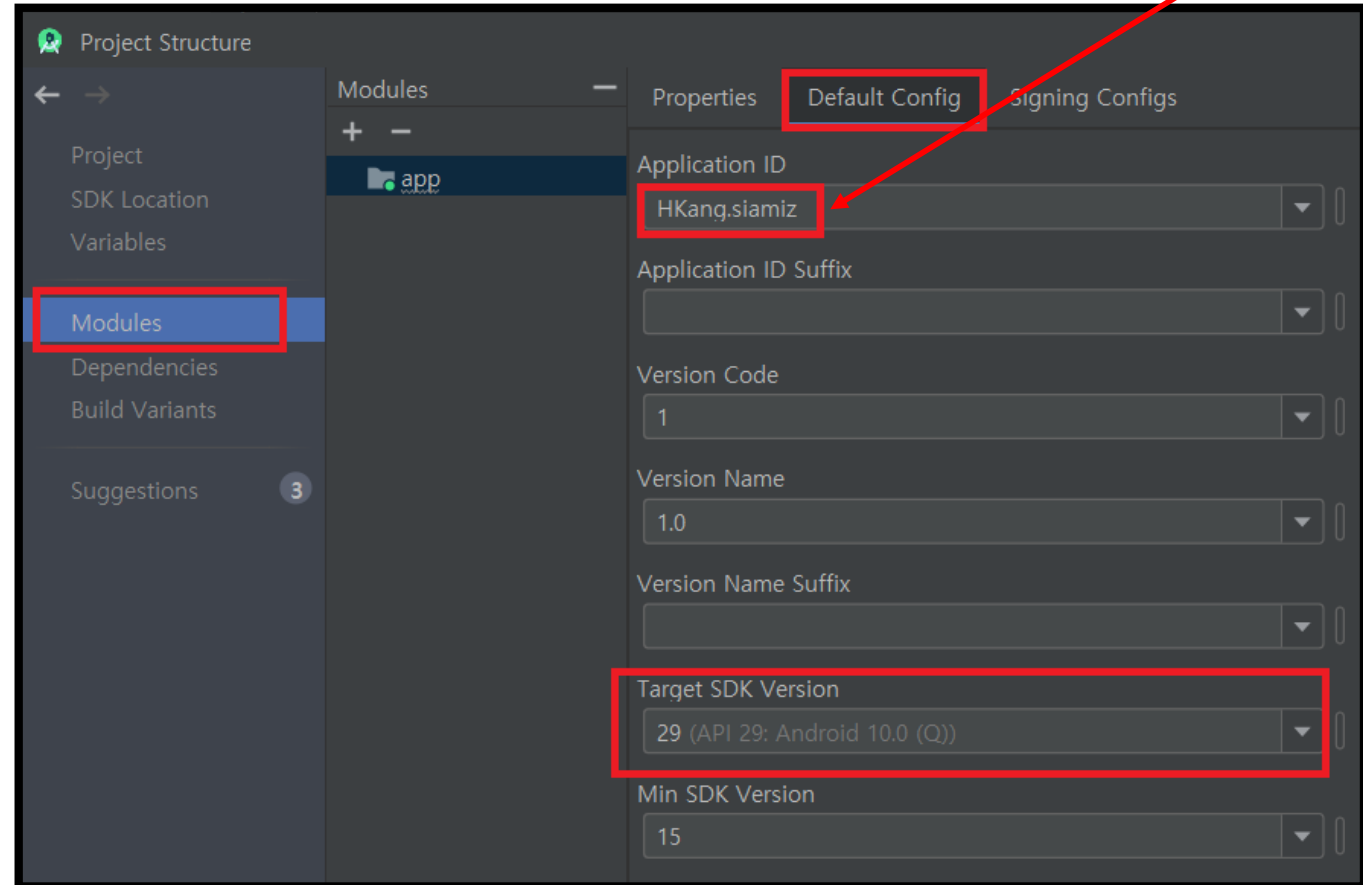
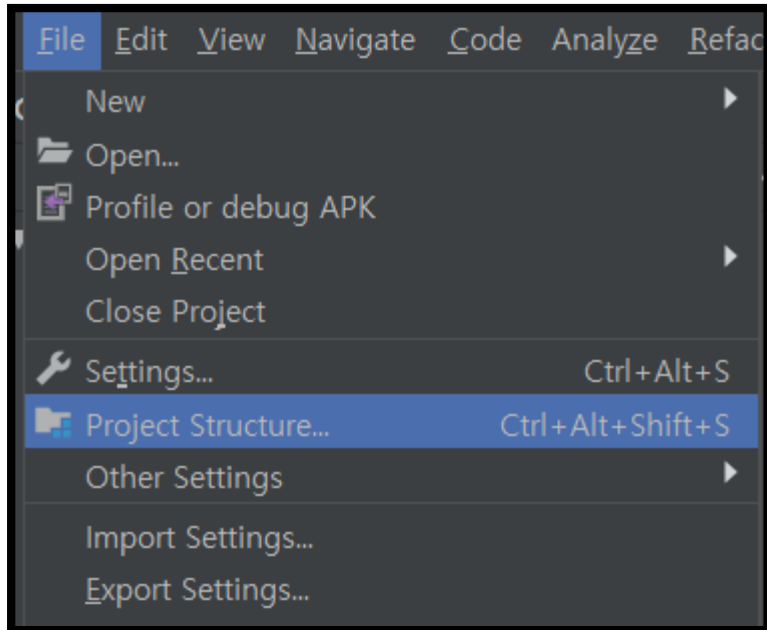
You have an error? Google may help you to generate APK 😊



# Project Setting



Add your student\_number  
to the end of the ID



app-release.apk

output.json

2020-03-30 오후 9:24

압축(APK) 파일

1,755KB

2020-03-30 오후 9:24

JSON 파일

1KB

**Upload these to your git repository.**

# Submission



## Deadline

- 4.17. midnight

Submit followings to [siamiz@khu.ac.kr](mailto:siamiz@khu.ac.kr).

- Make an apk file and upload it to your git repository. Then, share your git URL.
  - ✓ APK does not work: 0 point!
- {student\_number}\_{name}.zip including vertex.glsl and scene.cpp.
  - ✓ does not submit code: 0 point!

## TA

- 이정은 ([jeunlee0306@khu.ac.kr](mailto:jeunlee0306@khu.ac.kr)),
- 송현수 ([songhs@khu.ac.kr](mailto:songhs@khu.ac.kr))

## Office hour

- Monday, Wednesday 2:00 PM ~ 5:00 PM
- Contact TA by email before you visit.