

Advanced Computer Graphics

Lecture-08 Introduction to OpenGL-01 (based on python)

Tzung-Han Lin

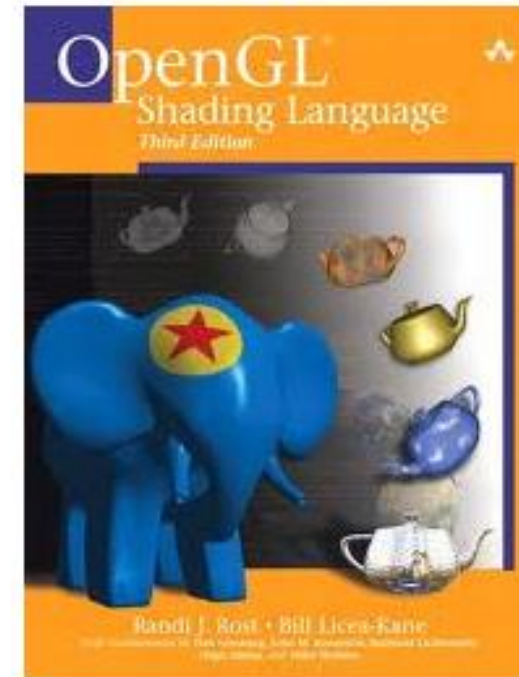
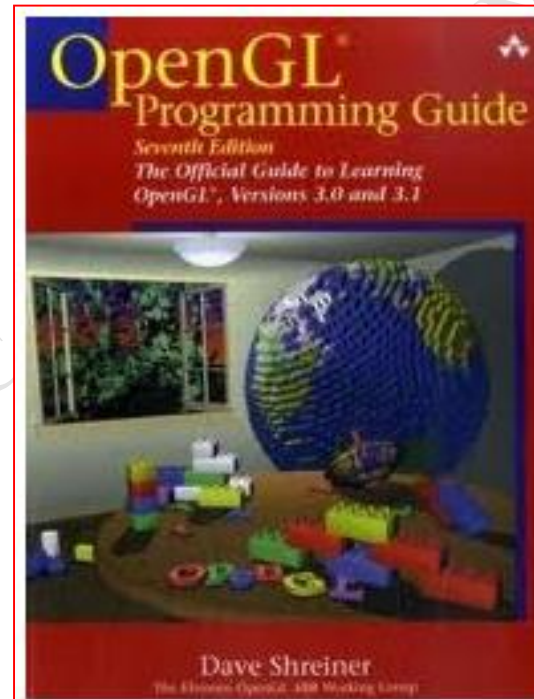
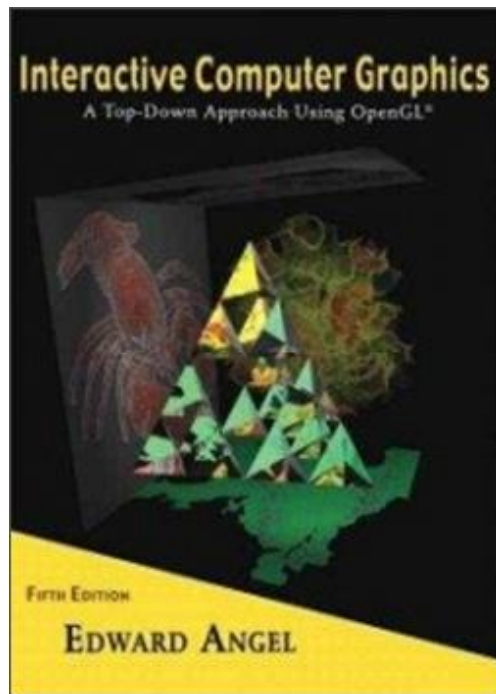
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Reference Textbook





Internet resource (up to date)



The Industry's Foundation for High Performance Graphics
FROM GAMES TO VIRTUAL REALITY, MOBILE PHONES TO SUPERCOMPUTERS

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OpenGL Headline News

Nsight Visual Studio Edition 5.4 now available

NVIDIA [Nsight Visual Studio Edition](#) for Microsoft Visual Studio allows you to build, debug, profile and trace heterogeneous compute, graphics, virtual reality, and UWP applications built with CUDA C/C++, OpenCL, DirectCompute, Direct3D, Vulkan, OpenGL, OpenVR, and the Oculus SDK. Check out the [OpenGL frame debugging](#), the new Range Profiler for instant GPU bottleneck analysis, and all the [new features](#).

Sep 05, 2017 | [Read article...](#) | [Permalink](#)

Possible OpenGL 4.6 real-time ray tracing and with polygons? Yes!

Around 2 years in development experimental real-time ray tracing, with polygons and OpenGL 4.6. Used mostly compute shaders. However, the project is very actively changing and developing. At moment in refactoring stage.

Aug 28, 2017 | [Read article...](#) | [Permalink](#)

New OpenGL 4.6 C++ wrapper - Diamond GL

Looking for a C++ wrapper for OpenGL? This new young wrapper is currently under heavy development. A similar library is also being developed for WebGL (tygi). Includes: STD library support, GLM library support, Support for "C++14" and Visual Studio.

Aug 28, 2017 | [Read article...](#) | [Permalink](#)

SilverLining 5.0 SDK Simulates Storm Clouds in OpenGL

Sundog Software released version 5.0 of the SilverLining Sky, 3D Cloud, and Weather SDK, featuring support for OpenGL 2.0 through 4.5. SilverLining is a C++ library that simulates real-time skies for any given time, location, and weather conditions. It implements a variety of volumetric rendering techniques to represent many different 3D cloud types in a physically realistic manner from any angle, while maintaining high frame-rates. SilverLining 5 introduces new hand-modeled storm clouds suitable for use in flight simulators. Large, natural-looking cumulonimbus thunderheads and towering cumulus clouds in various stages of development are included. SilverLining integrates into any OpenGL application easily with simple calls to initialize, update, and draw its skies, clouds, and precipitation effects. Integration code for OpenSceneGraph is included. SilverLining is widely used in the training and simulation industry, and powers the popular "SkyMaxx Pro" add-on for the X-Plane flight simulator.

Aug 18, 2017 | [Read article...](#) | [Permalink](#)



Download OpenGL
[Getting Started with OpenGL](#)
[Official OpenGL 4.6 feedback thread](#)
[OpenGL Reference Cards](#)
[OpenGL Registry](#)
[OpenGL Conformant Products](#)



Getting Started with Vulkan
[Vulkan Reference Cards](#)



Getting Started with OpenGL ES
[OpenGL ES Reference Cards](#)



Getting Started with WebGL
[WebGL 2.0 Specification](#)
[WebGL 1.0 Specification](#)
[WebGL Public Wiki](#)
[WebGL Reference Cards](#)



What you need for first step based on python

- Install “python” via Anaconda
 - Manually install following three packages
 1. “PyOpenGL”
 2. “PyOpenGL_accelerate”
 3. “freeglut”



Install “anaconda” on you PC

- Find download link, ex Anaconda3-2020.02-Windows-x86_64.exe

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Data science technology for human sensemaking.

A movement that brings together millions of data science practitioners,
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Anaconda3-2020.
02-Windows-x86
_64.exe

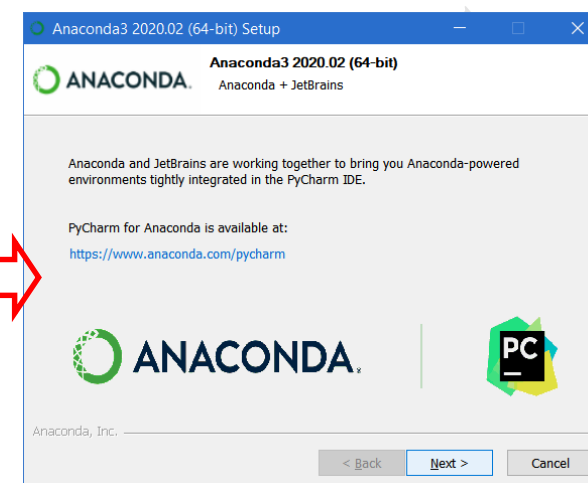
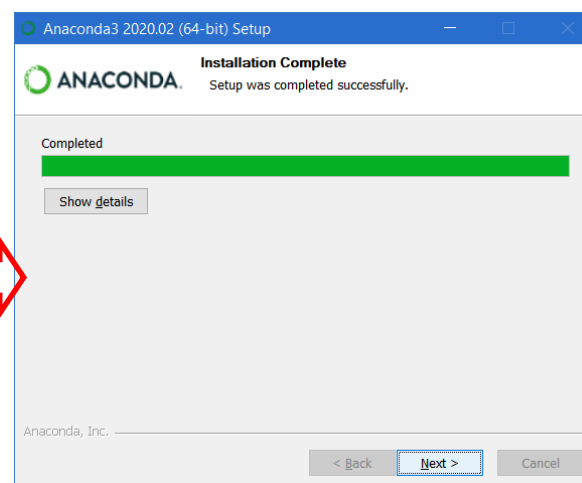
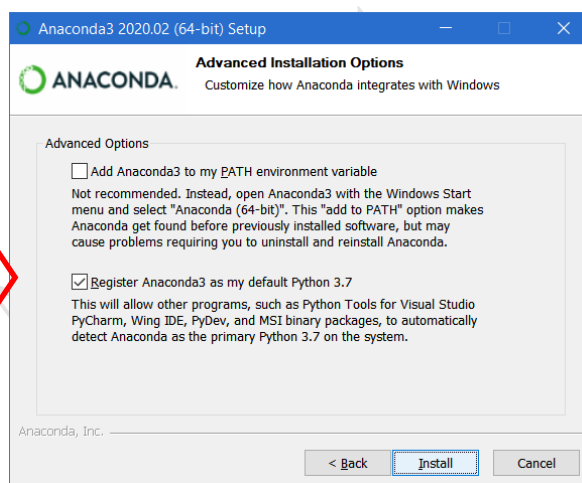
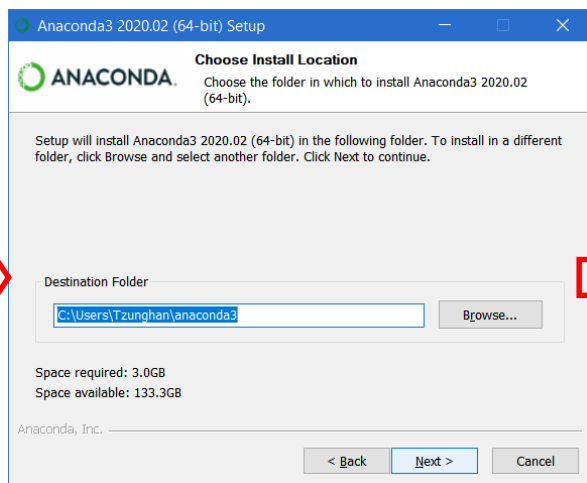
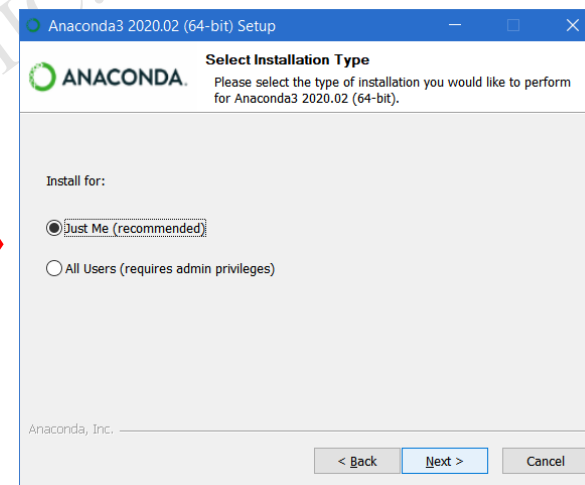
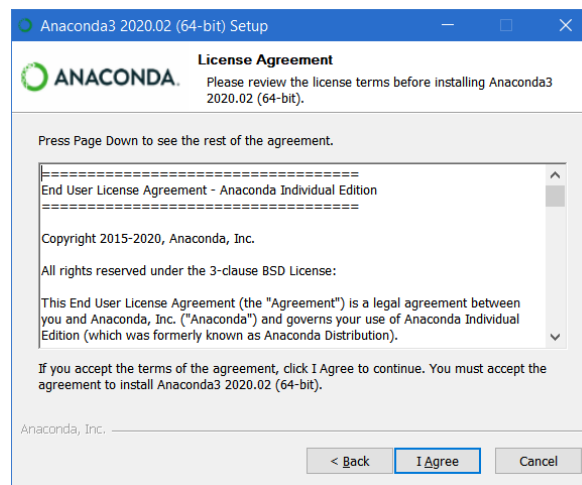
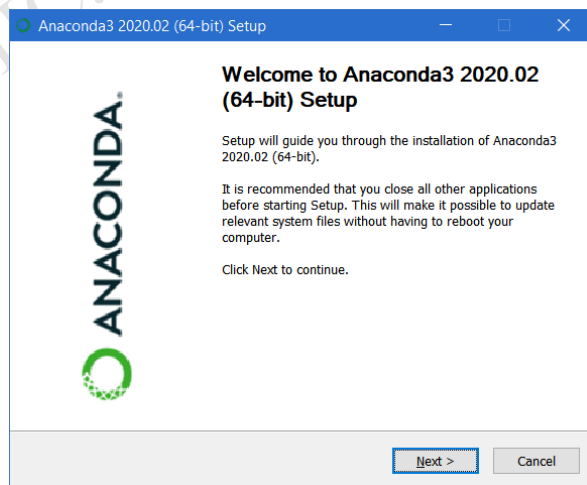
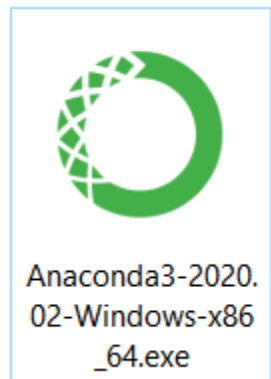


Description

- Anaconda → GUI interface package for python application
- PyOpenGL → OpenGL fundamental library (python version)
- PyOpenGL_accelerate → OpenGL GPU lib. (python version)
- Freeglut → Framework (window interface) GUI for OS



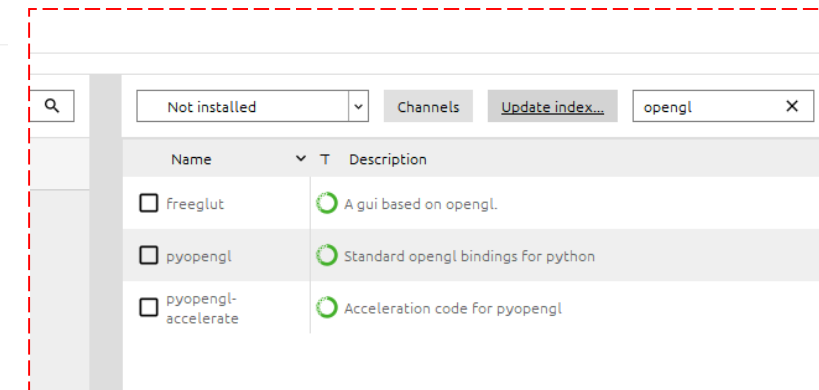
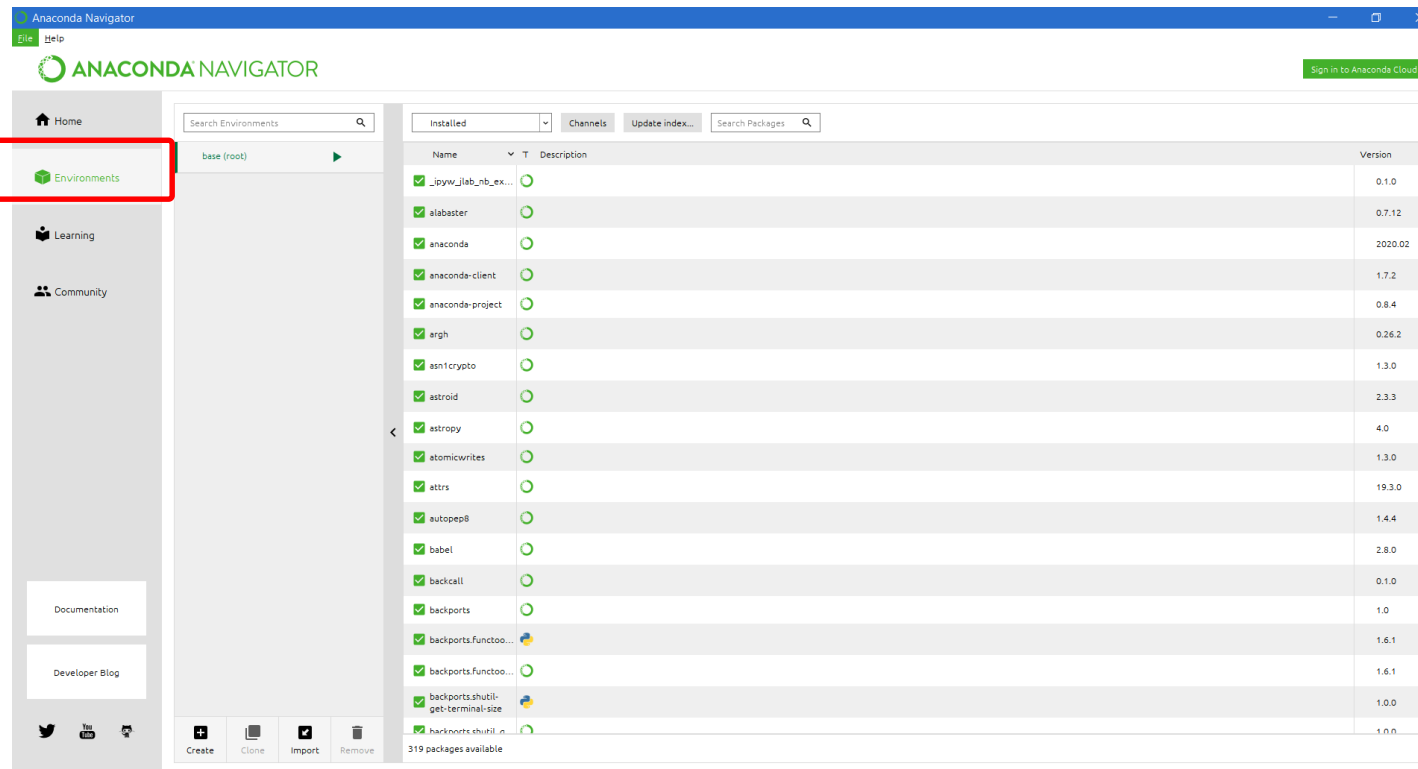
Installation - Anaconda





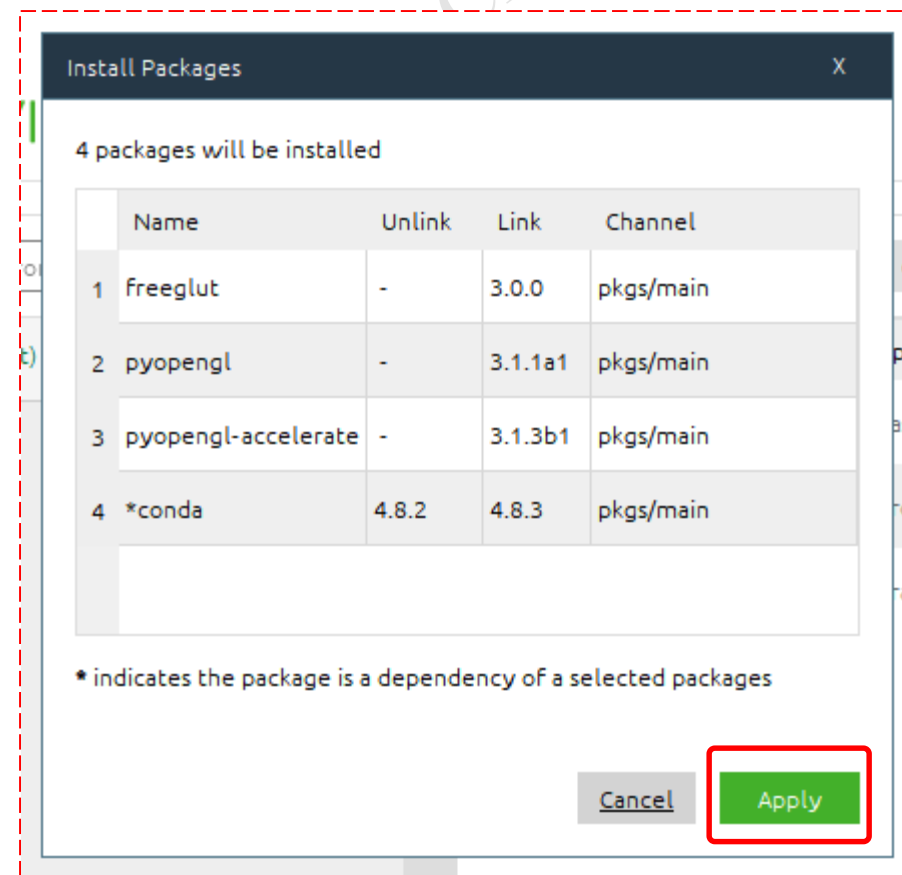
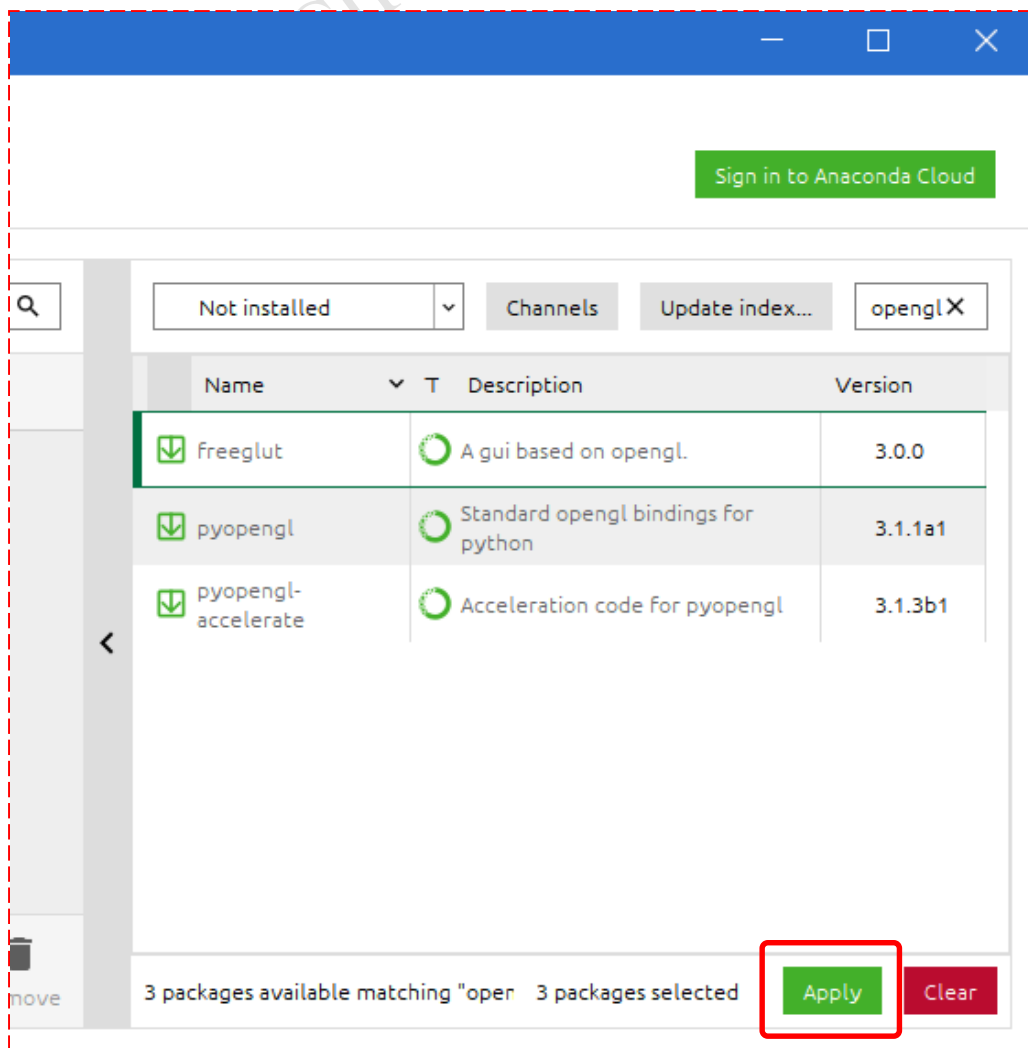
Installation - openGL

- Open “Anaconda Navigator” App, switch to “Environments”
- Search “openGL” in “not installed” page, then check them to apply





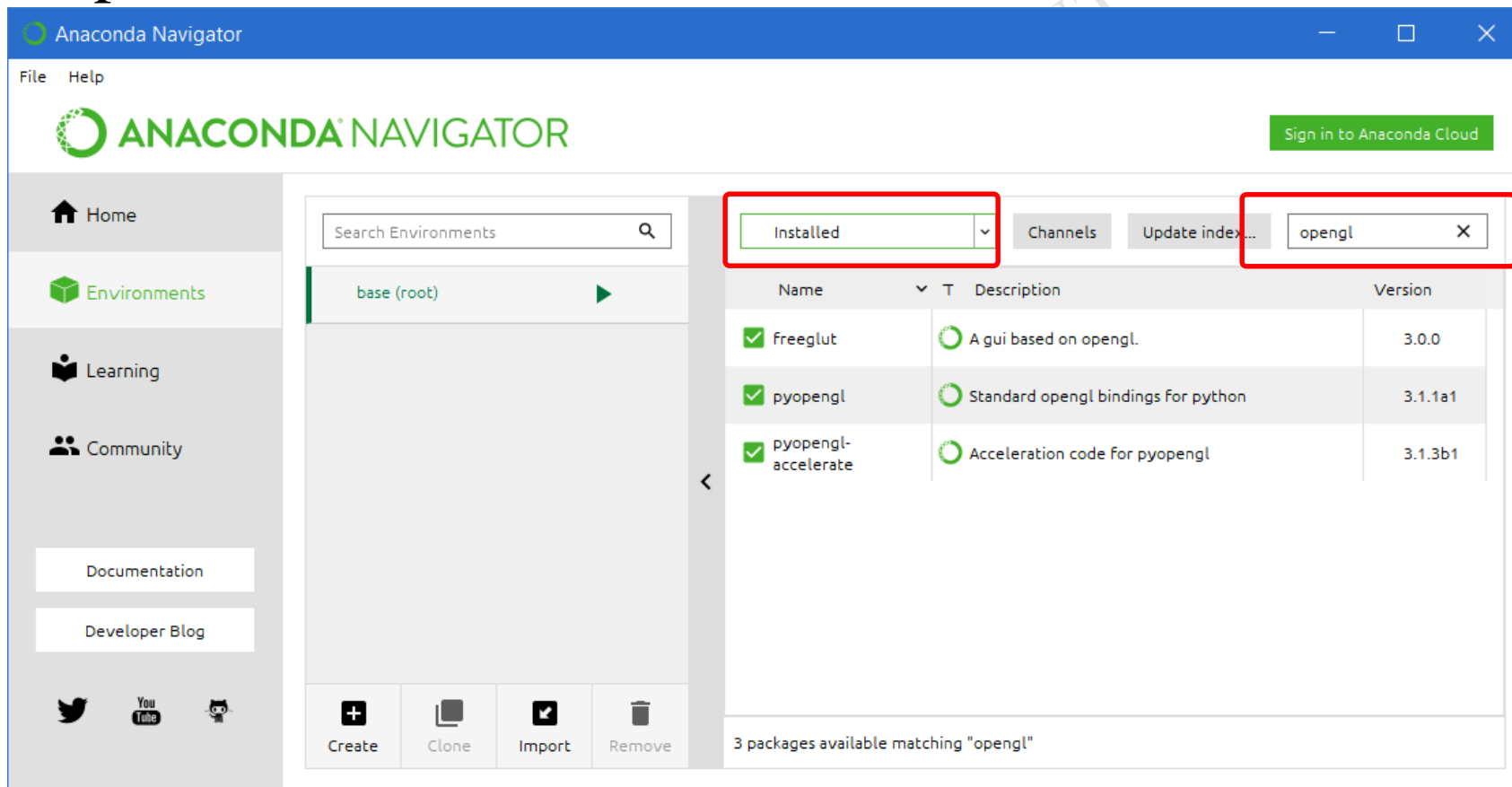
Installation - openGL





Installation - openGL

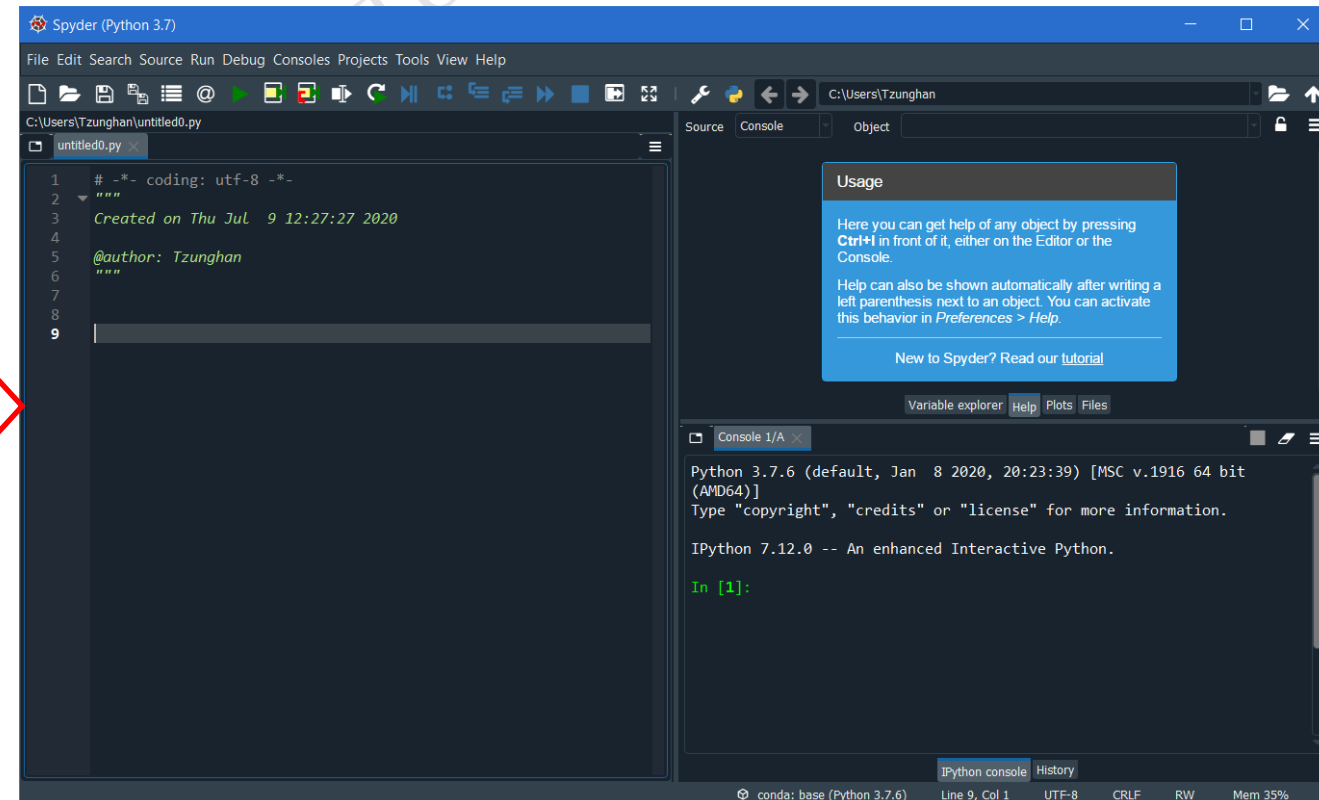
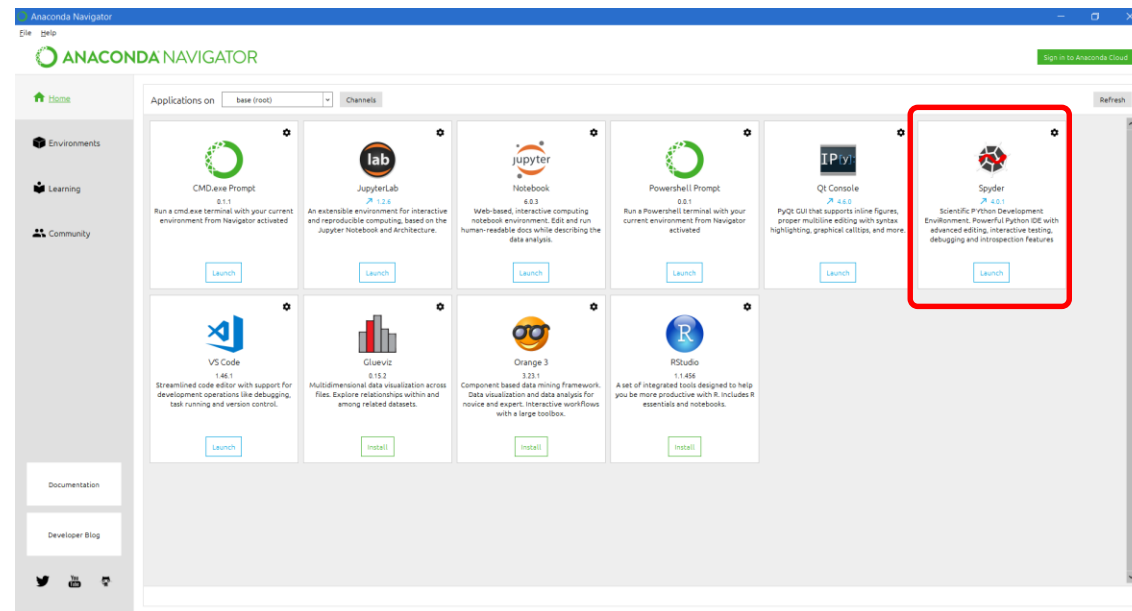
- Make sure three openGL components are installed, then close anaconda and reopen it





After installation of anaconda

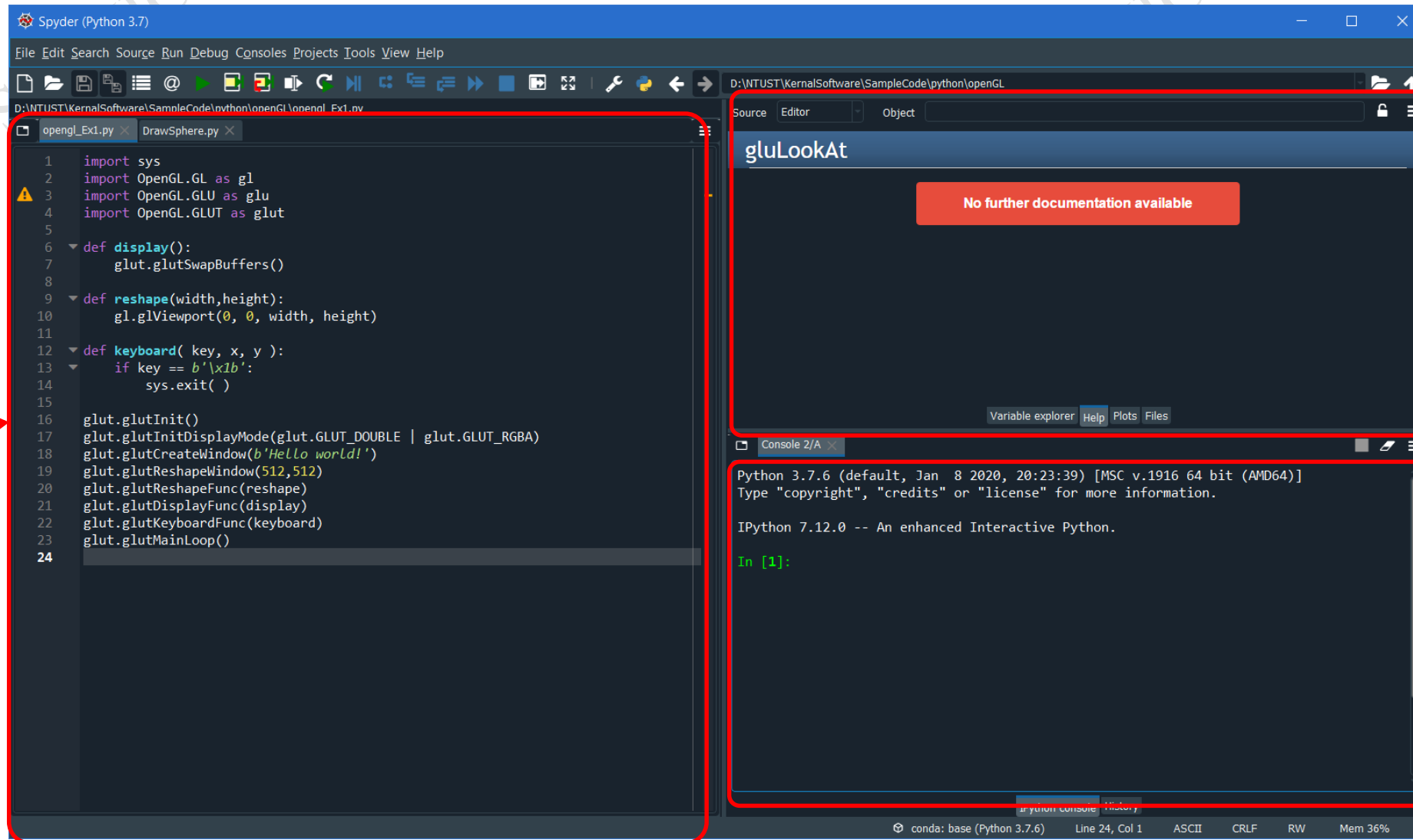
■ Launch “Spyder” GUI tool





Create your first program

Your program
(source code) →



← Info. / Help

← Console
(output)

```
import sys
import OpenGL.GL as gl
import OpenGL.GLU as glu
import OpenGL.GLUT as glut
```

To include/import all necessary lib.

```
def display():
    glut.glutSwapBuffers()
```

Function for openGL
→ drawing content for one frame

```
def reshape(width,height):
    gl.glViewport(0, 0, width, height)
```

Function for openGL
→ Action for window is resized

```
def keyboard( key, x, y ):
    if key == b'\x1b':
        sys.exit( )
```

Function for openGL
→ Action for press key

```
glut.glutInit()
glut.glutInitDisplayMode(glut.GLUT_DOUBLE | glut.GLUT_RGBA)
glut.glutCreateWindow(b'Hello world!')
glut.glutReshapeWindow(512,512)
glut.glutReshapeFunc(reshape)
glut.glutDisplayFunc(display)
glut.glutKeyboardFunc(keyboard)
glut.glutMainLoop()
```

Main program



Try to run the first example to create OpenGL window based on freeglut.

```

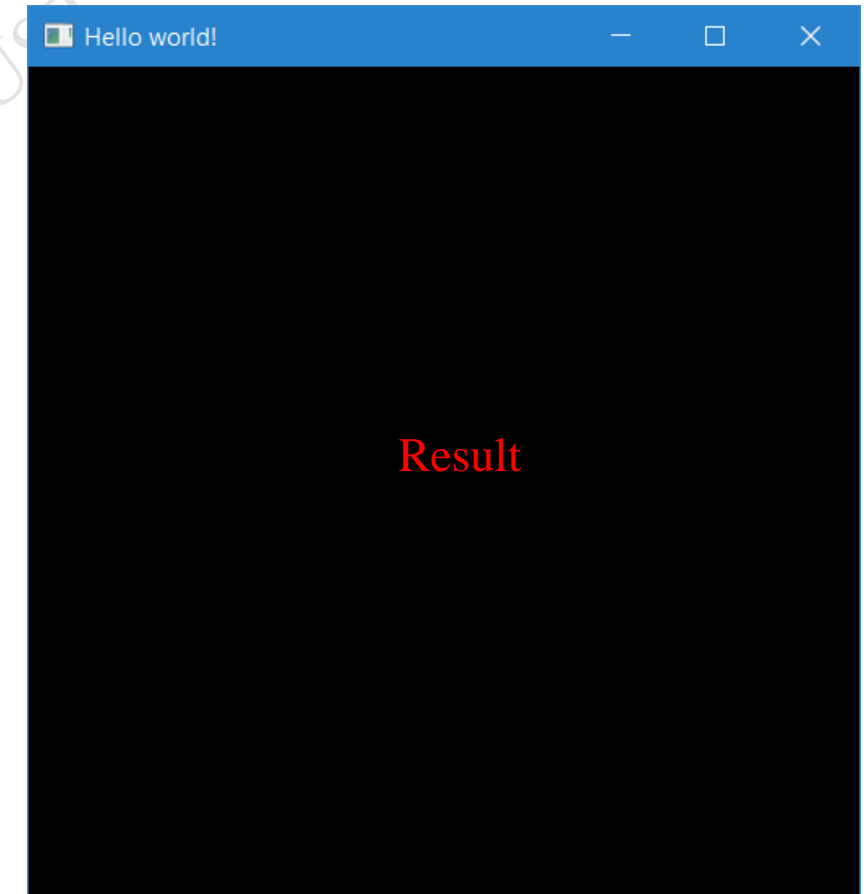
Python 3.7.6 (default, Jan 8 2020, 20:23:39) [MSC v.1916 64 bit (AMD64)]
Type "copyright", "credits" or "license()" for more information.

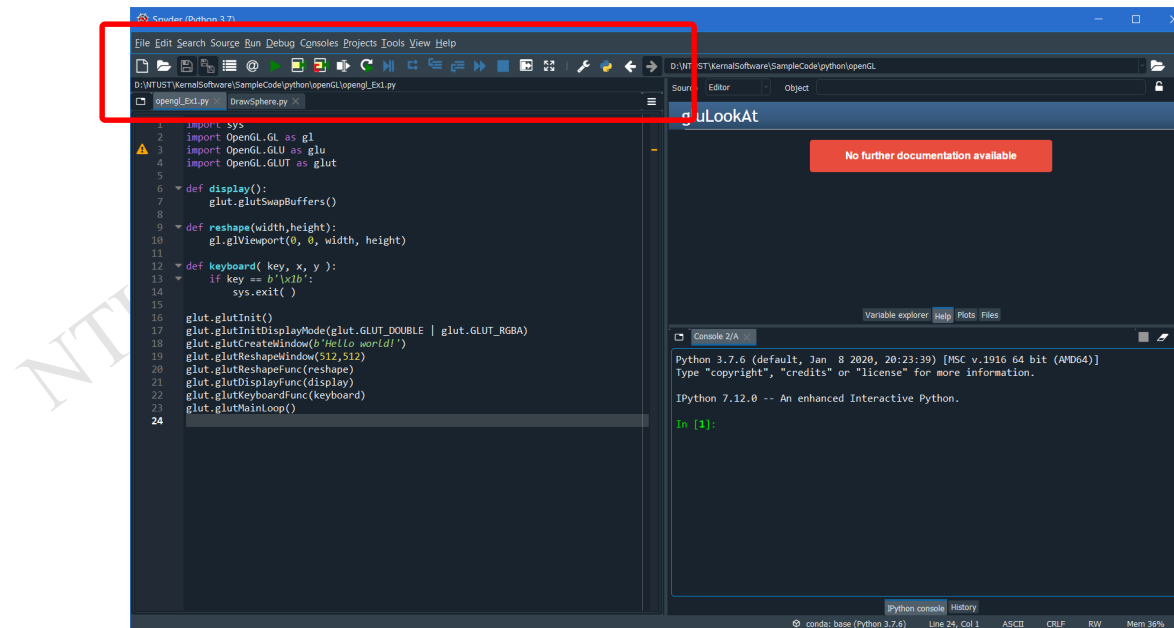
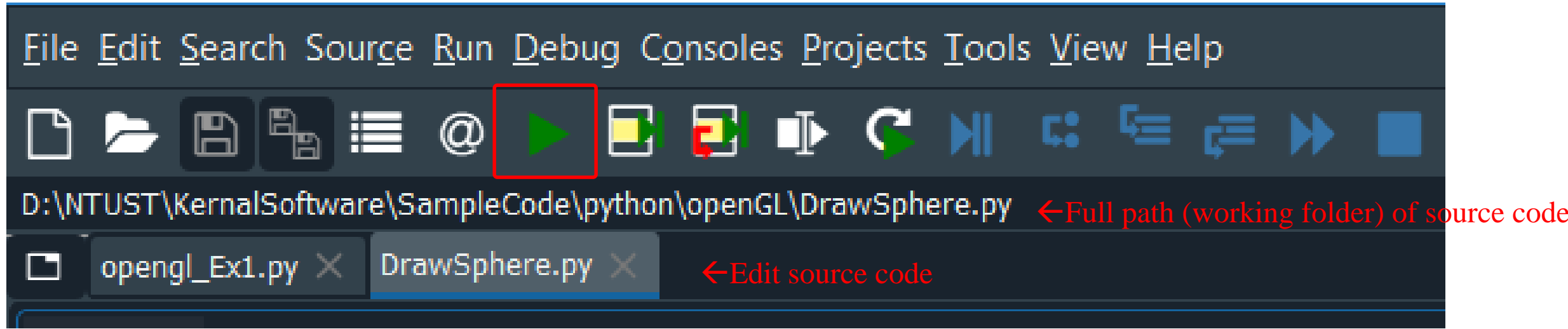
IPython 7.12.0 -- An enhanced Interactive Python.

In [1]: runfile('D:/NTUST/KernalSoftware/SampleCode/python/OpenGL/DrawSphere.py', wdir='D:/NTUST/
KernalSoftware/SampleCode/python/OpenGL')

In [1]: runfile('D:/NTUST/KernalSoftware/SampleCode/python/OpenGL/opengl_Ex1.py', wdir='D:/NTUST/
KernalSoftware/SampleCode/python/OpenGL')
    
```

Result in console
(mostly Text output info.)





NTUST.CIIC.



OpenGL online learning course

- Everything of OpenGL.
- All examples are available (mostly in C/C++)





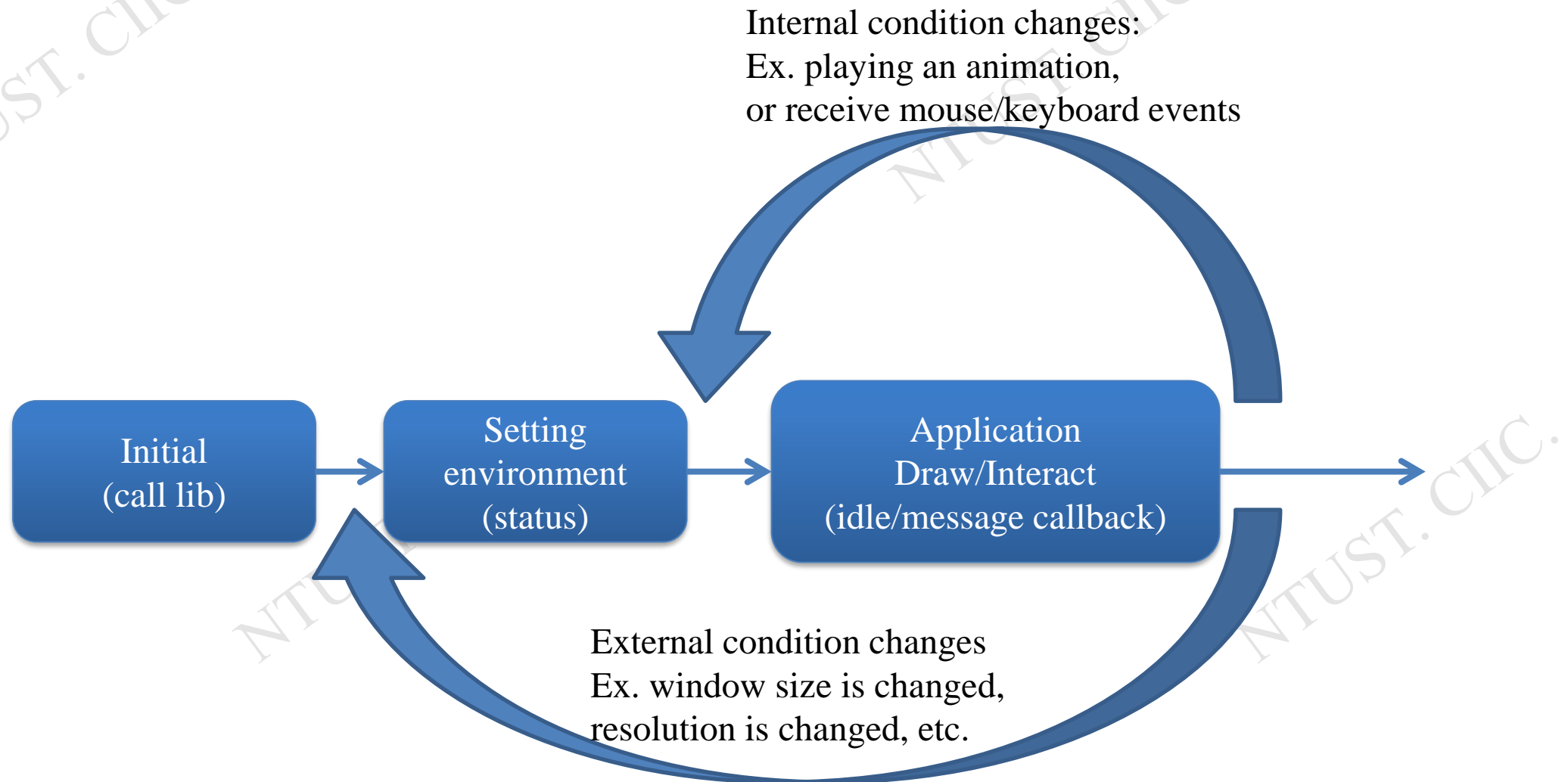
Short history--OpenGL

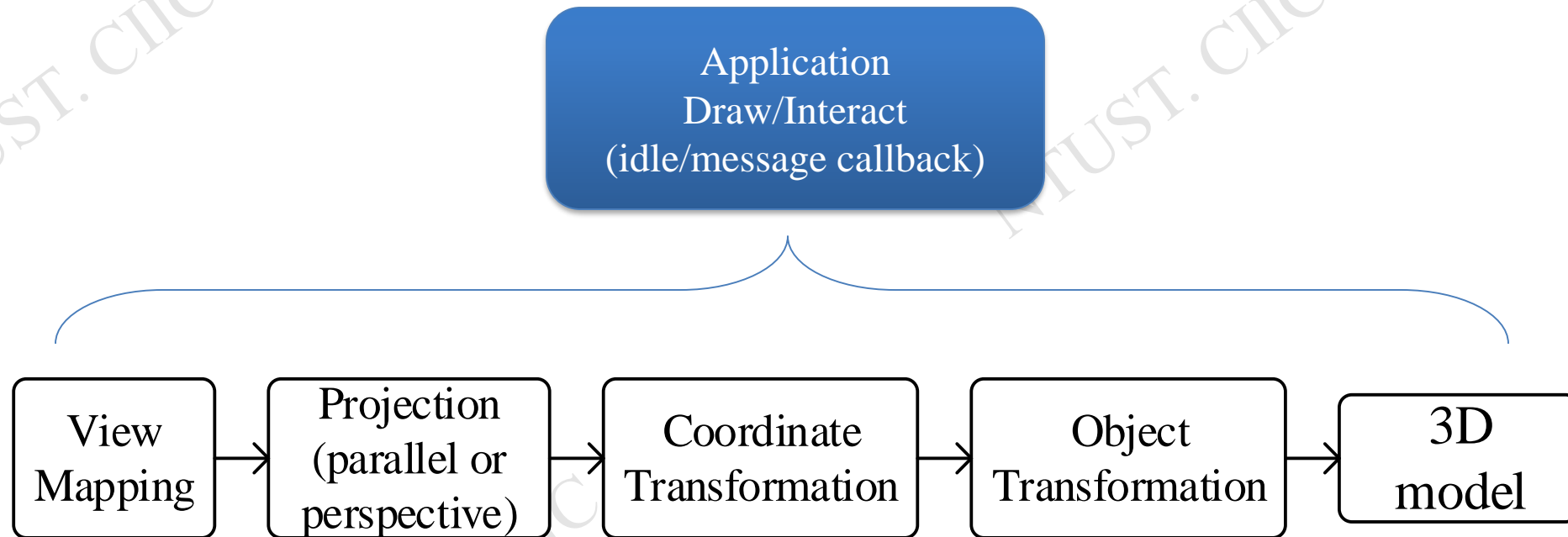
- 1994 Jul.: OpenGL 1.0 (fixed function)
- 2004 Sept.: OpenGL 2.0 (extend)
- 2009 Mar: OpenGL 3.1 (shader)
- 2009 Aug.: OpenGL 3.2 (additional shader)
- 2010 Jul.: OpenGL 4.1 tessellation

- Current Version: (2019 Aug)
- OpenGL 4.6
- OpenGL ES 3.x, Embedded System
- WebGL (ES 2.0)



Message and event in graphics interface





*程式Pipeline剛好與上課講述步驟相反(出現次序)

*openGL矩陣定義與上課講述都是Transpose關係

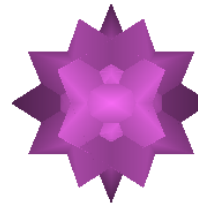
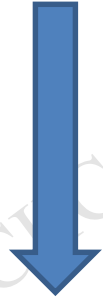


Hierarchical structure by blocked by push-pop matrix

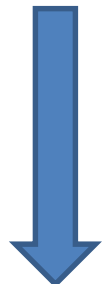
 → The original model



glPushMatrix ()
glScale(2)
glPopMatrix()



glPushMatrix ()
glScale(2)
glPopMatrix()

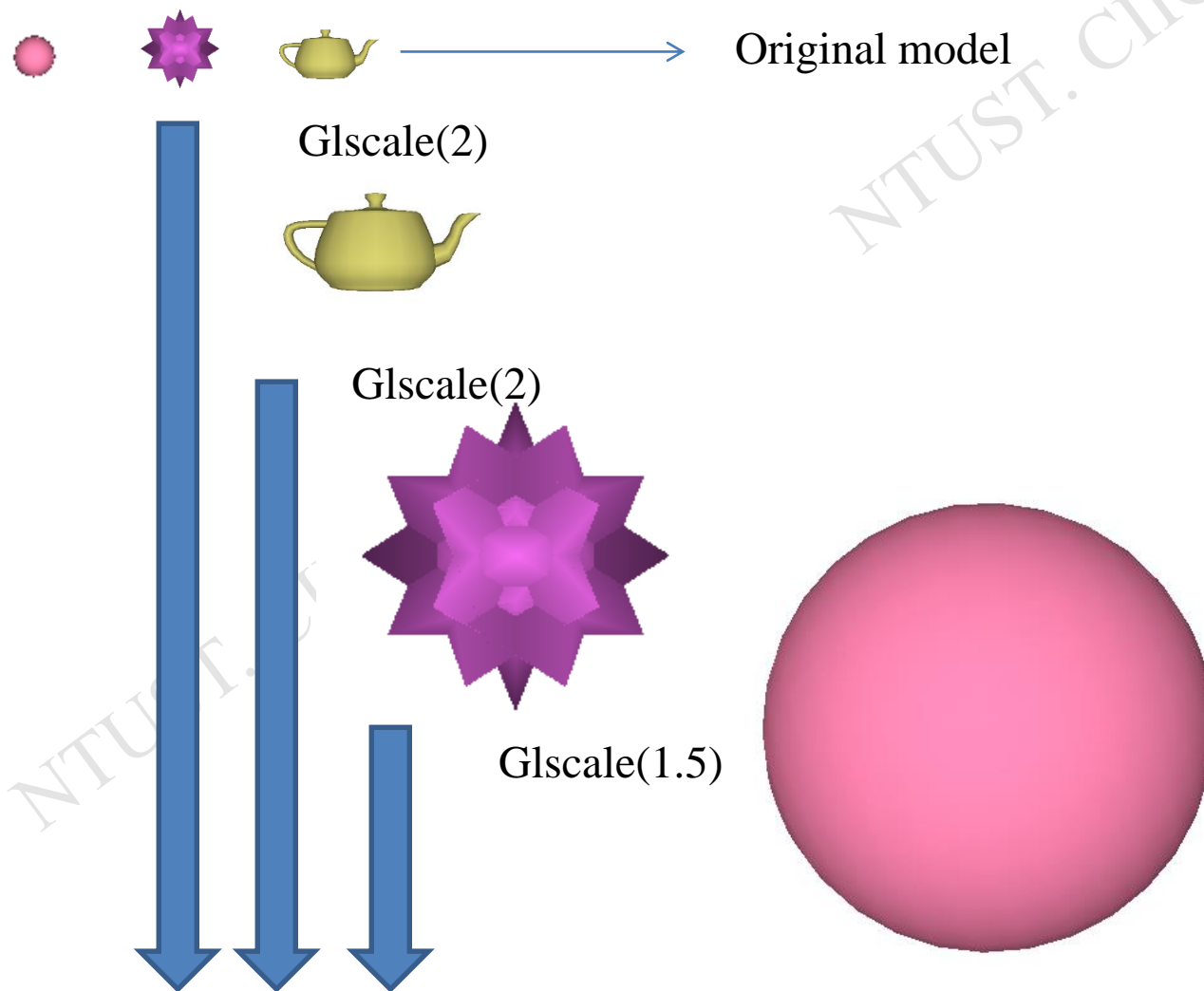


glPushMatrix ()
glScale(1.5)
glPopMatrix()

*避免受矩陣階層式架構干擾(包覆)

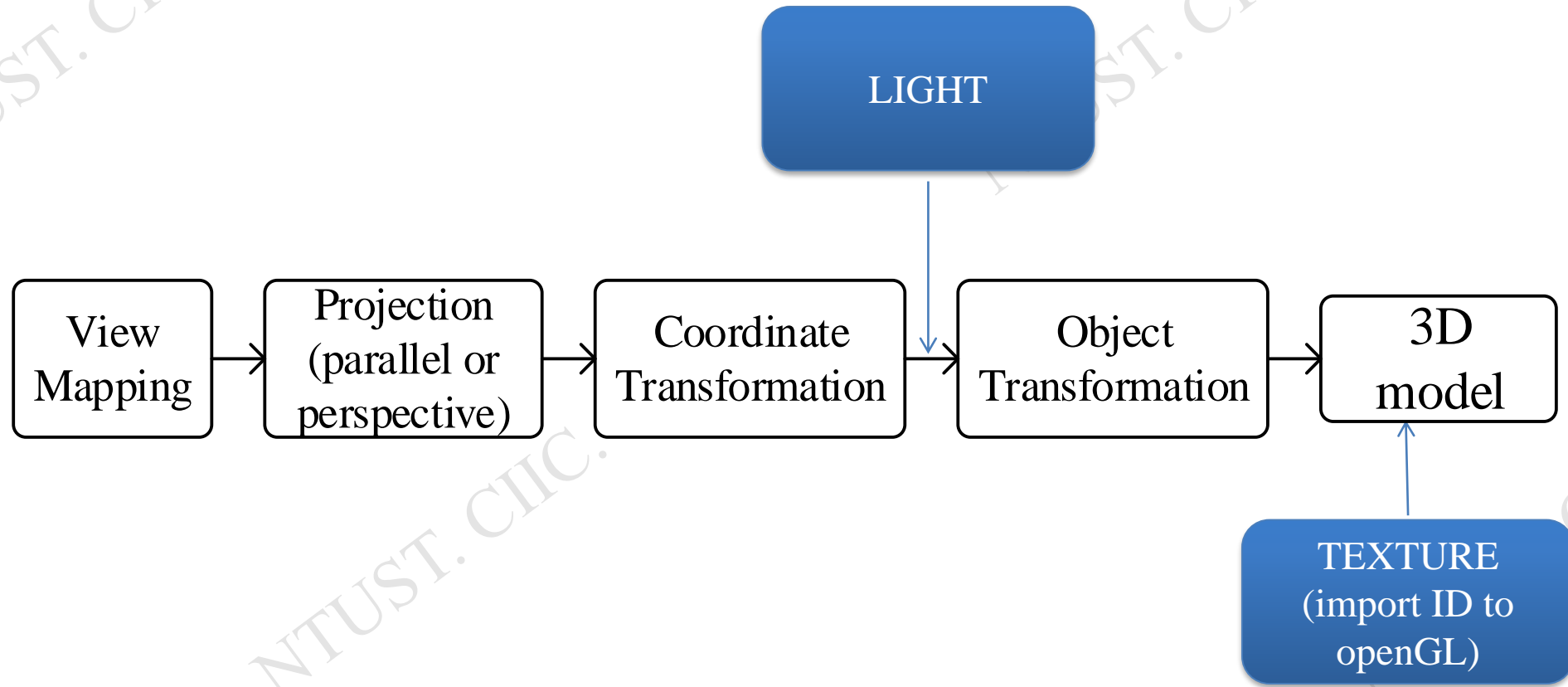


Hierarchical structure





Color (Light and Texture) in pipeline





Higher level tools

- Higher Level Libraries built on OpenGL

Leading software developers use OpenGL, with its robust rendering libraries, as the 2D/3D graphics foundation for higher-level APIs. Developers leverage the capabilities of OpenGL to deliver highly differentiated, yet widely supported vertical market solutions. Open Inventor, IRIS Performer, OpenGL Optimizer, OpenGL Volumizer, OpenGL Shader, Scene Graph APIs.

Open Inventor® by VSG

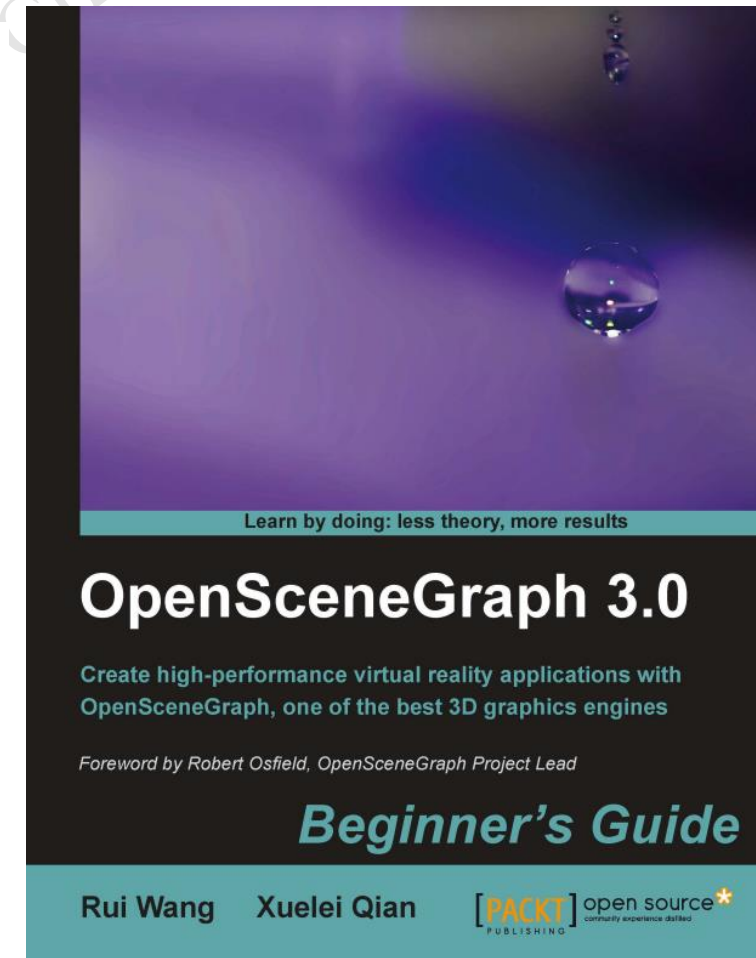
Open Inventor® by VSG is the commercial, current evolution of Open Inventor and provides an up-to-date, highly-optimized, full-featured implementation of the popular object-oriented scenegraph API for C++, .NET and Java. Applications powered by Open Inventor by VSG also benefit from powerful extensions such as VolumeViz LDM for very large volume data, MeshViz XLM for high-performance mesh support, or ScaleViz for multi-GPUs and immersive VR.

OpenSceneGraph

OSG is a open source high performance 3D graphics toolkit, used by application developers in fields such as visual simulation, games, virtual reality, scientific visualization and modelling. Written entirely in Standard C++ and OpenGL it runs on all Windows platforms, OSX, Linux, IRIX, Solaris and FreeBSD operating systems.

Quesa3D

Quesa is a high level 3D graphics library, released as Open Source under the LGPL, which implements Apple's QuickDraw 3D API on top of OpenGL. It supports both retained and immediate mode rendering, an extensible file format, plug-in renderers, a wide range of high level geometries, hierarchical models, and a consistent and object-orientated API. Quesa currently supports Mac OS, Linux, and Windows - ports to Be and Mac OS X are in progress.





Important habit in OpenGL

- glEnd() comes with glBegin(???)
- glPopMatrix comes with glPushMatrix
- Know the “STATE” for setting glEnable() in program flow



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