OpenGL

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3D Modeling and Processing Lab

OpenGL

- 2차원 및 3차원 컴퓨터 그래픽스를 위한 cross-language, multi-platform API

OpenGL APIs

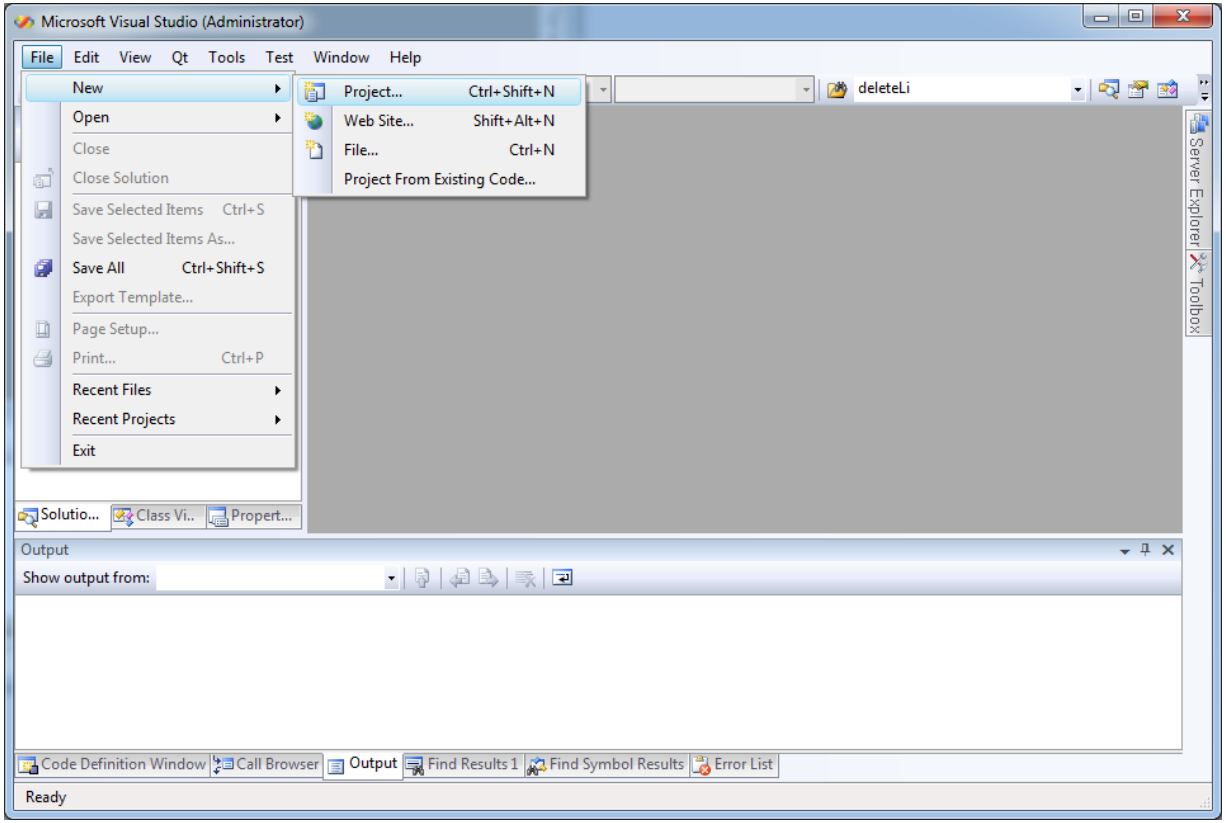
- OpenGL core library
  - Gl.h opengl32.lib opengl32.dll
- GLU(OpenGL Utility Library) – part of openGL
  - Glu.h glu32.lib glu32.dll
- GLUT(OpenGL Utility Toolkit) – not part of openGL
  - Glut.h glut32.lib glut32.dll
- openGL Extensions
  - Glew, etc…

Installation

- Mark Kilgard가 개발한 GLUT는 open source가 아니고 업데이트되지 않기 때문에 freeglut 사용
- http://www.transmissionzero.co.uk/software/freeglut-devel/
- Freeglut 2.8.0 MSVC Package 다운

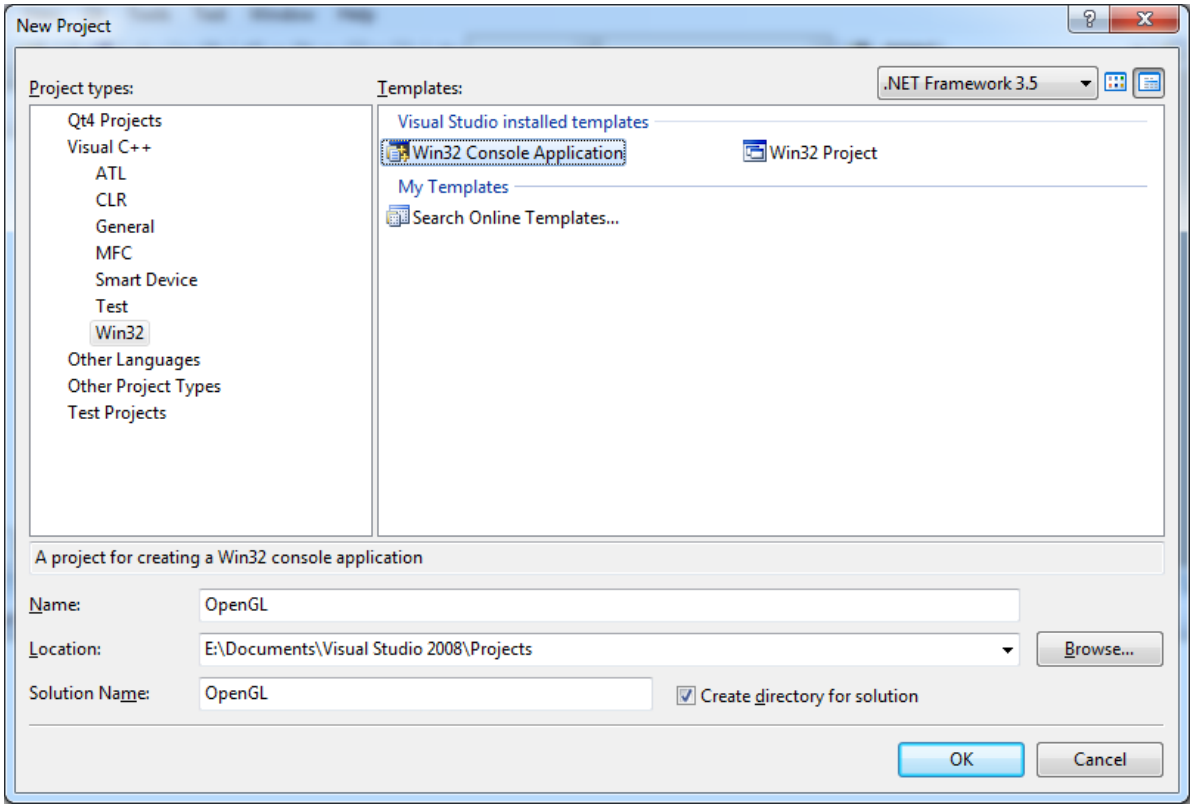
Project Setting

- New visual studio project



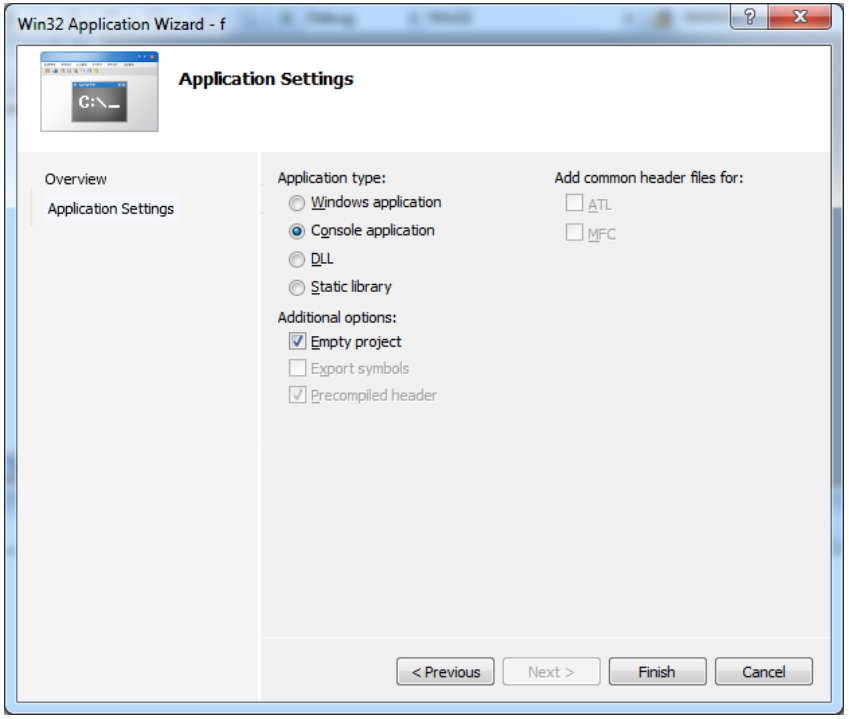
Project Setting

- Win32 Console Application



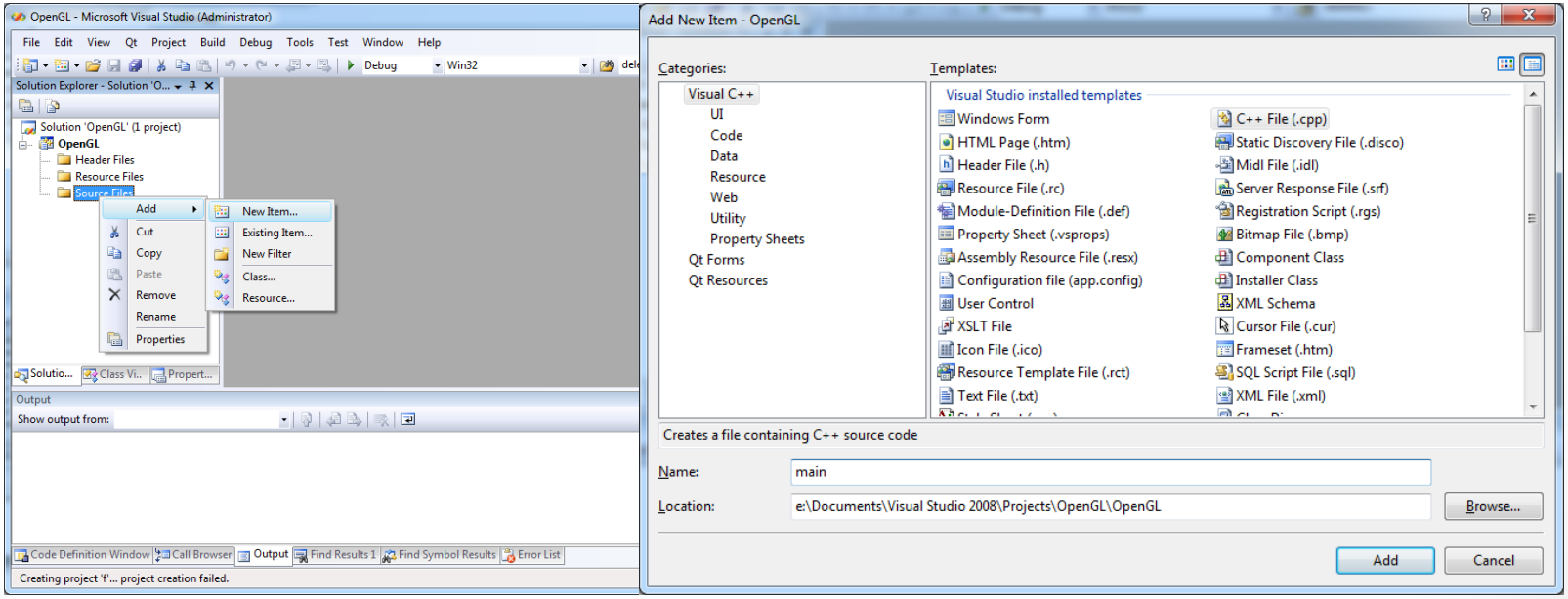
Project Setting

- Empty project



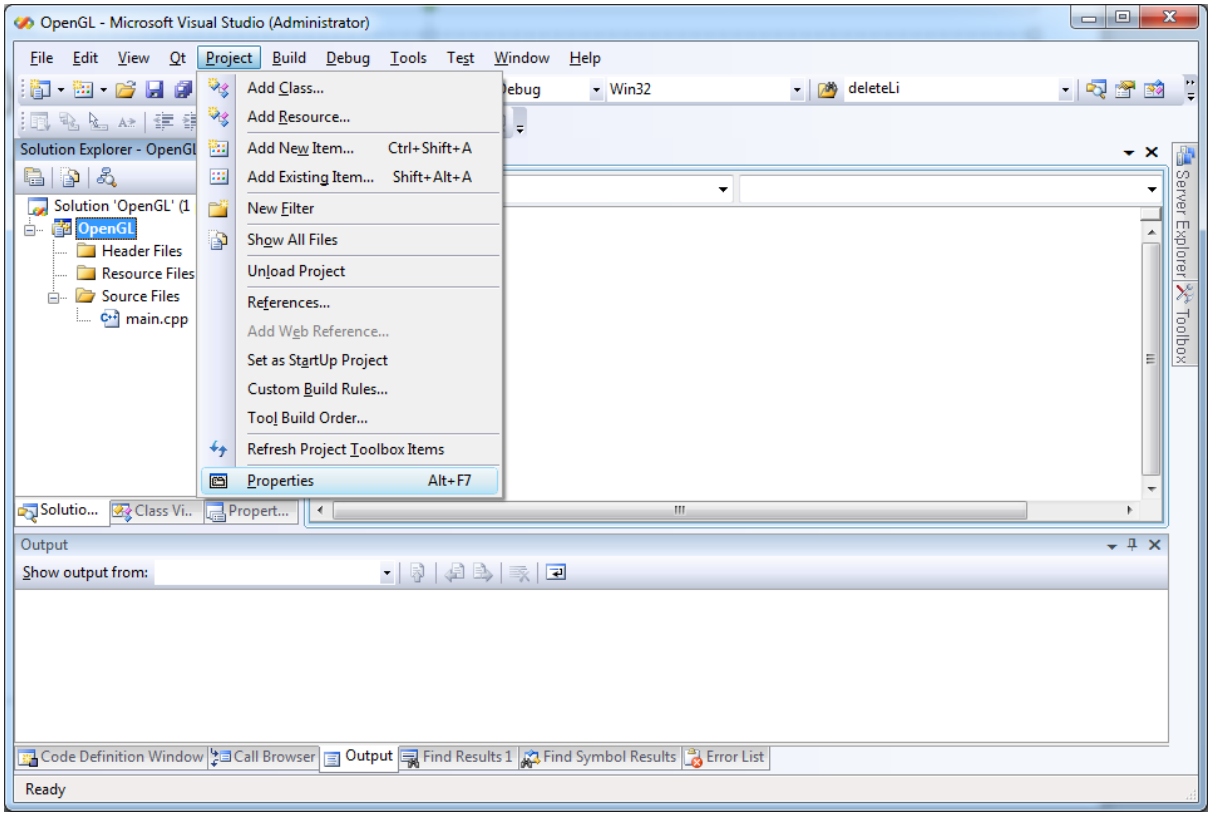
Project Setting

- Add new item
- C++ file



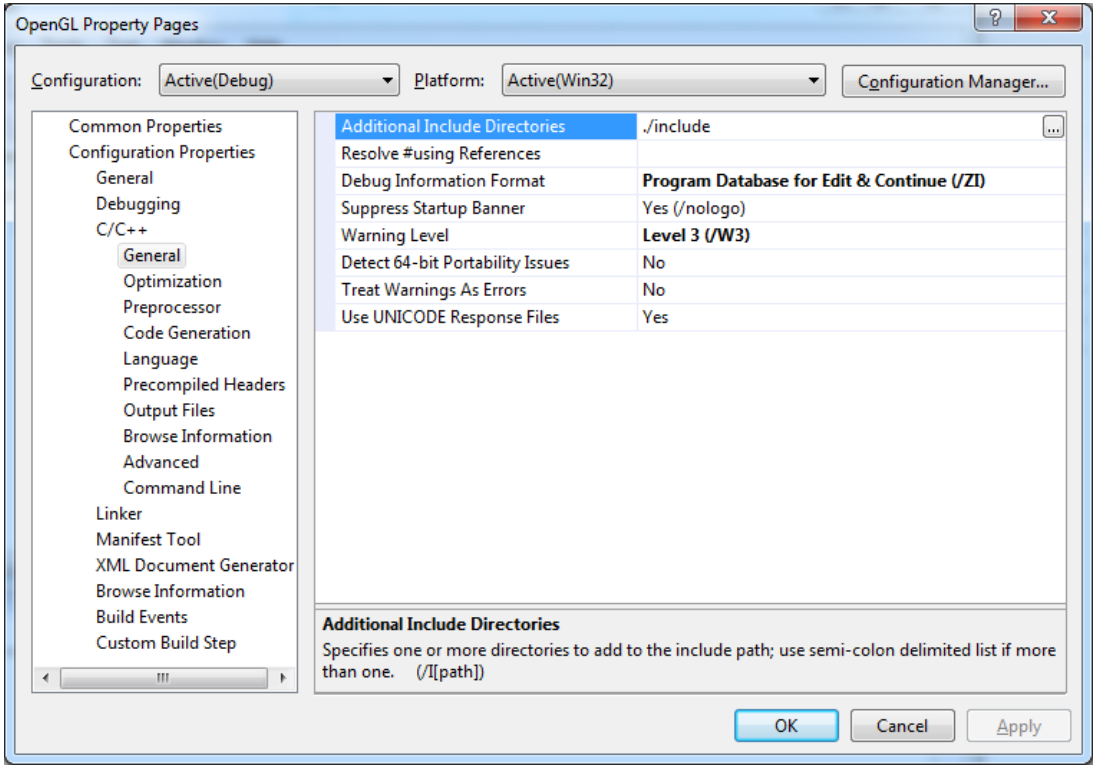
Project Setting

- Project properties



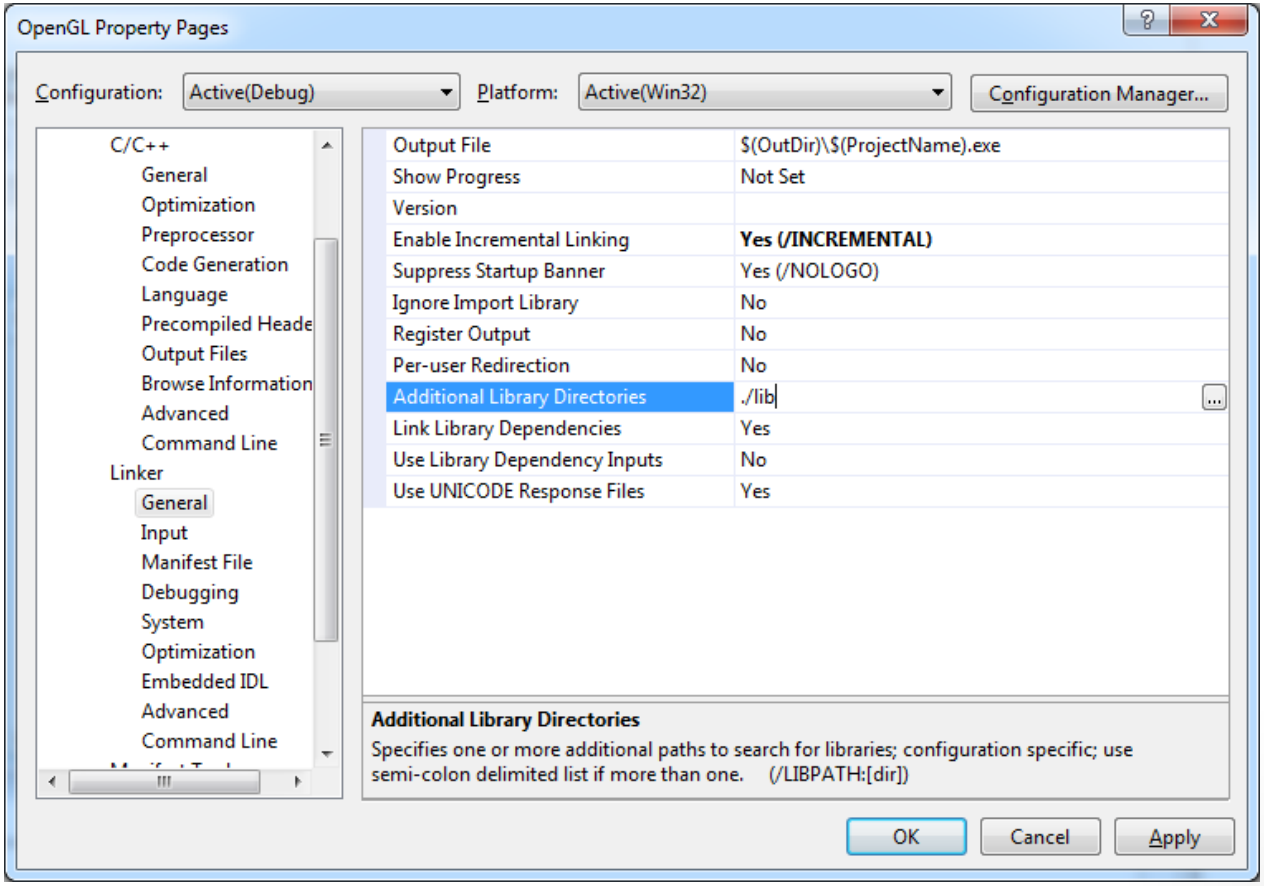
Project Setting

- Copy *.h, *.lib and freeglut.dll to /include, /lib, and ./ folders respectively.
- Change include directories (to use *.h)



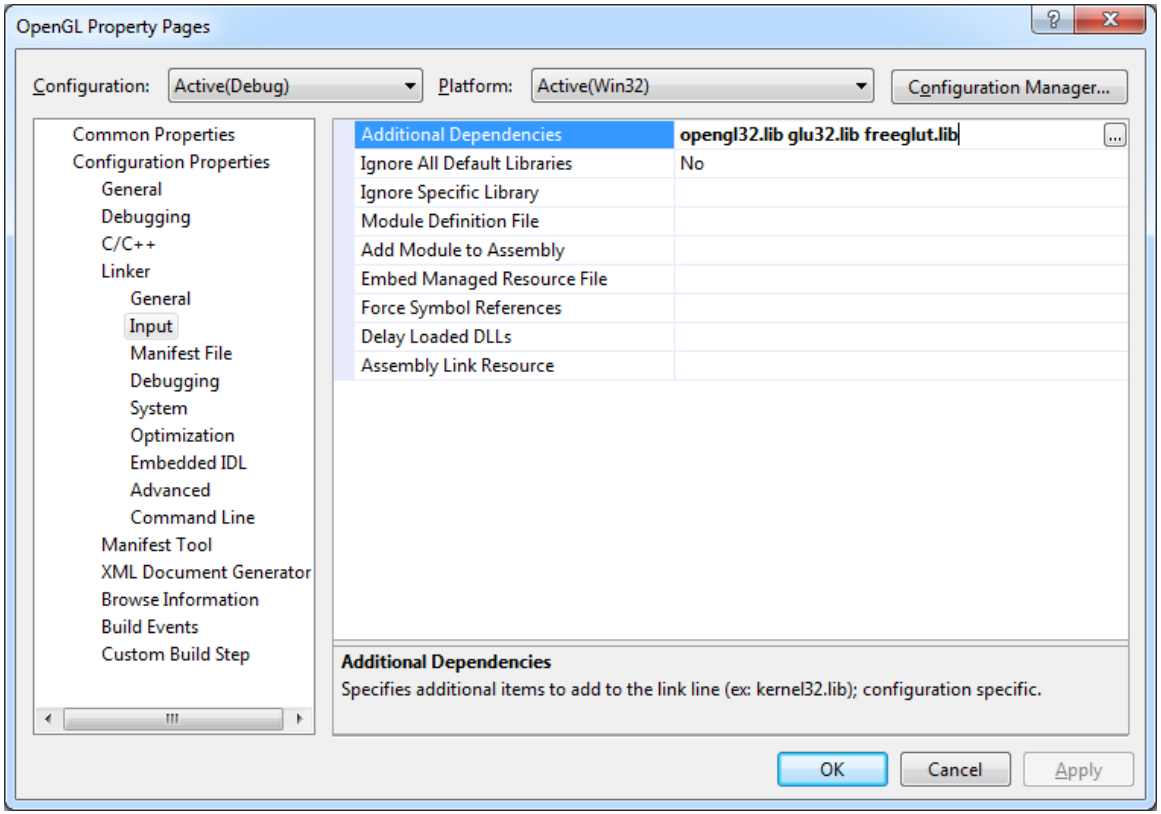
Project Setting

- Change library directories (to use *.lib)



Project Setting

- Add additional dependencies as follows.

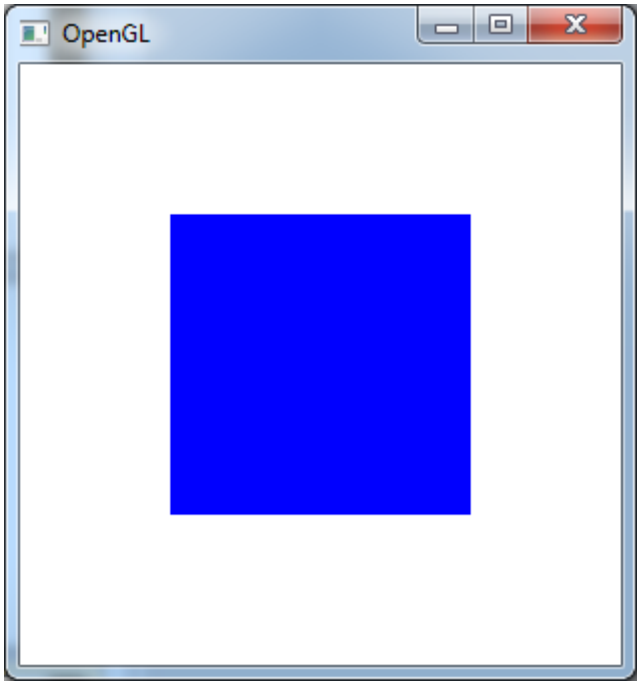


Code example

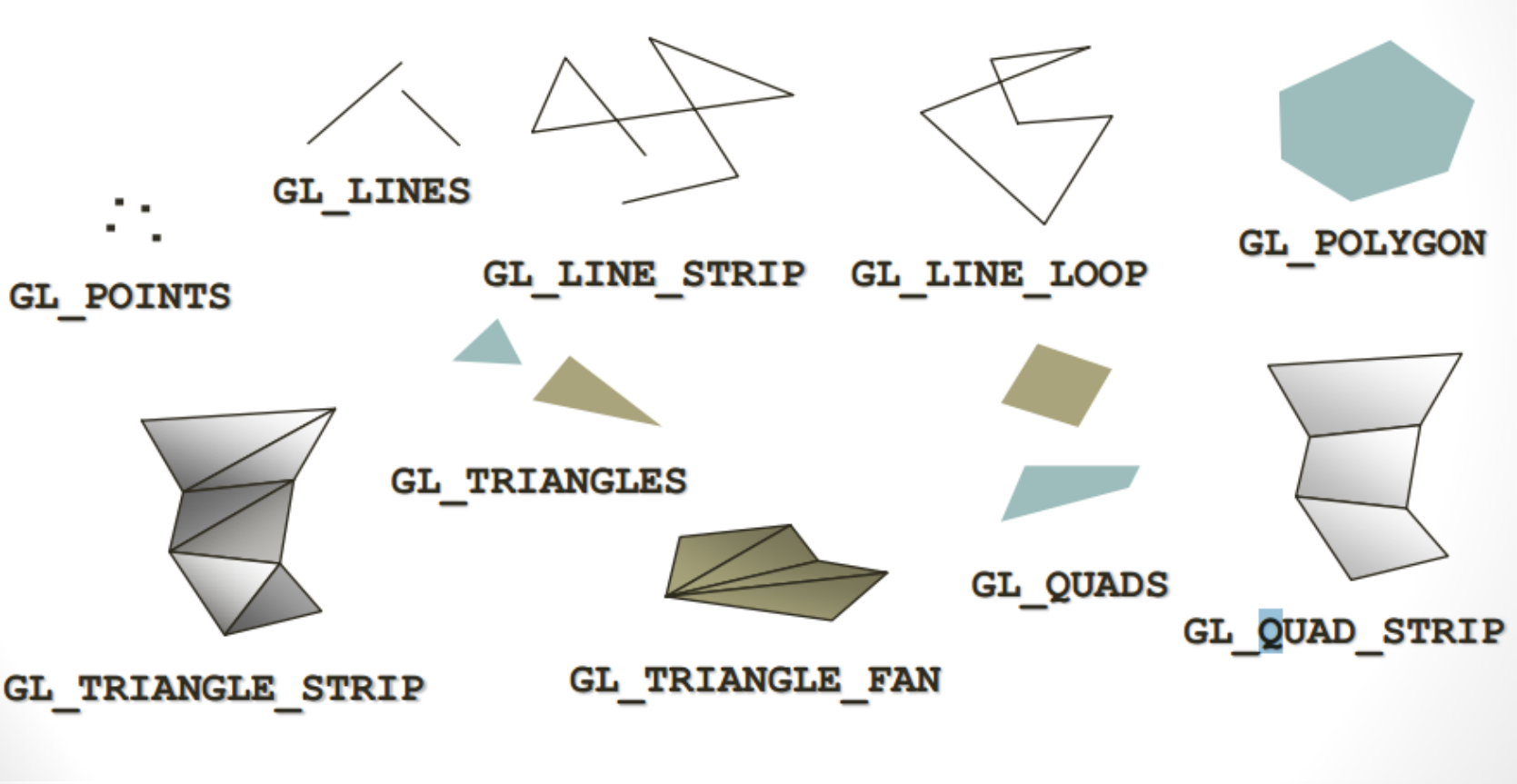
main.cpp

(Global Scope)

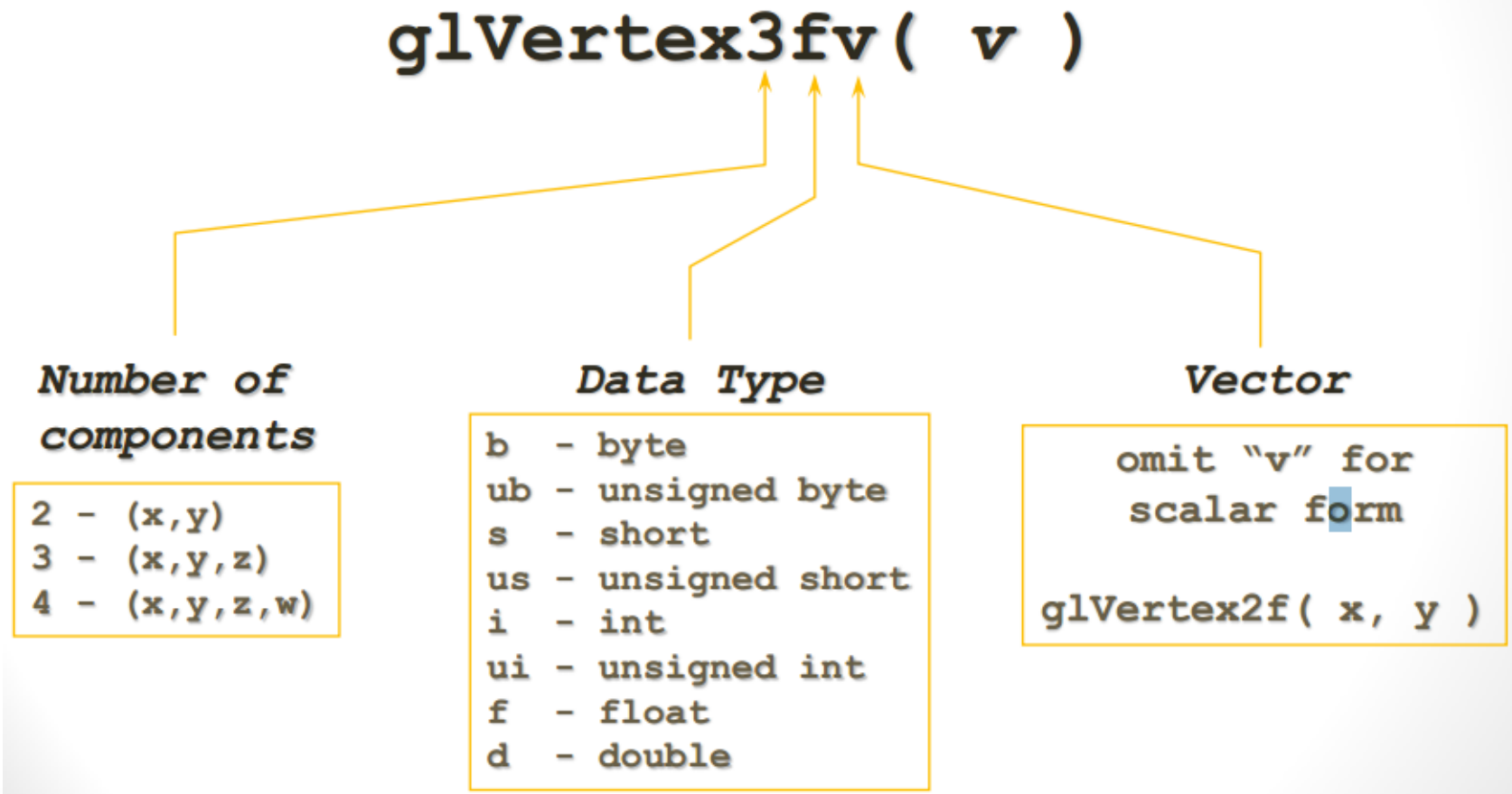
```
1  #include <GL/freeglut.h>
2
3  void display(){
4      glClearColor(1.f,1.f,1.f,1.f);
5      glClear(GL_COLOR_BUFFER_BIT);
6      glColor3f(0.f,0.f,1.f);
7      glBegin(GL_POLYGON);
8          glVertex2f(-.5f,-.5f);
9          glVertex2f(.5f,-.5f);
10         glVertex2f(.5f,.5f);
11         glVertex2f(-.5f,.5f);
12     glEnd();
13     glFinish();
14 }
15
16 int main(int argc,char** argv){
17     glutInit(&argc,argv);
18     glutCreateWindow("OpenGL");
19     glutDisplayFunc(display);
20     glutMainLoop();
21     return 0;
22 }
```



OpenGL Primitives



Drawing Primitives

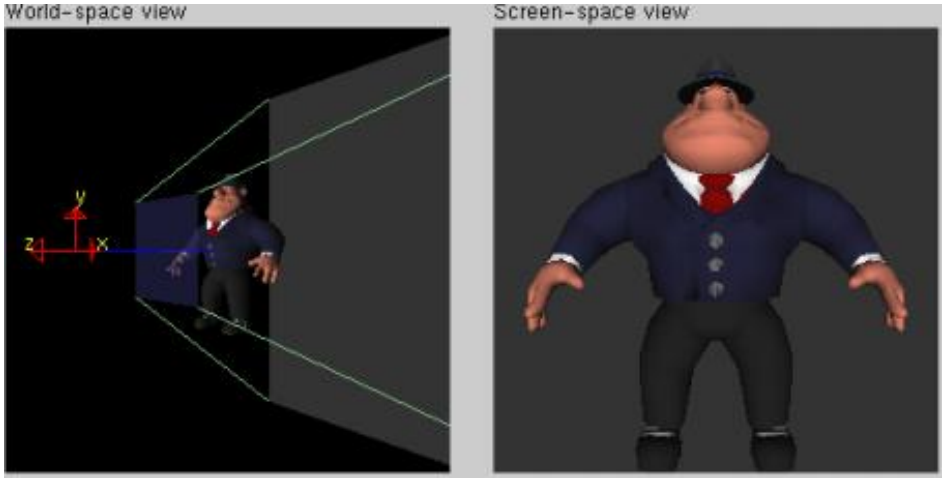


Modelview & Projection matrix

- Modelview Matrix
  - The relative transformation between object and camera
  - glTranslate()
  - glRotate()
  - glScale()
  - gluLookAt()
- Projection Matrix
  - Clipping volume (viewing frustum)
  - Projection to screen
  - glOrtho()
  - gluOrtho2D()
  - glFrustum()
  - gluPerspective()
- Common
  - glMatrixMode()
  - glLoadIdentity()
  - glPushMatrix()
  - glPopMatrix()

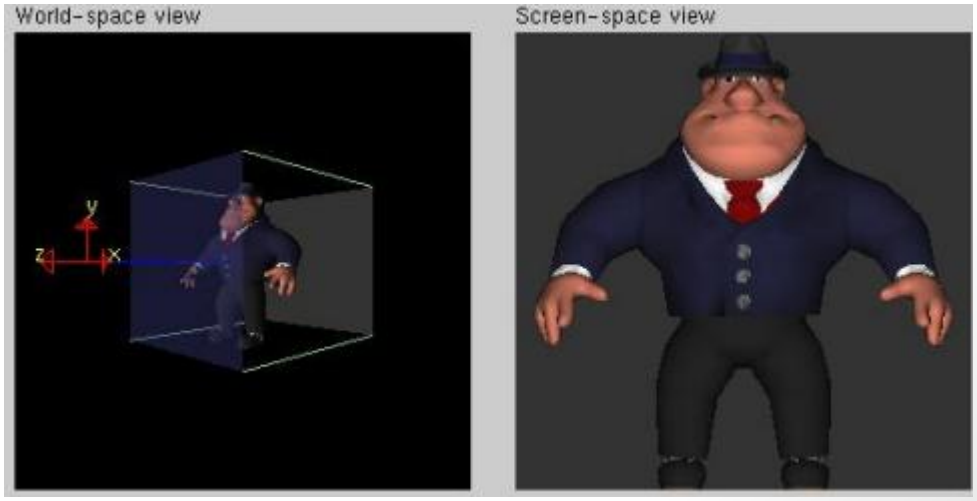
Projection transformation

- Projection transformation



gluPerspective

glOrtho

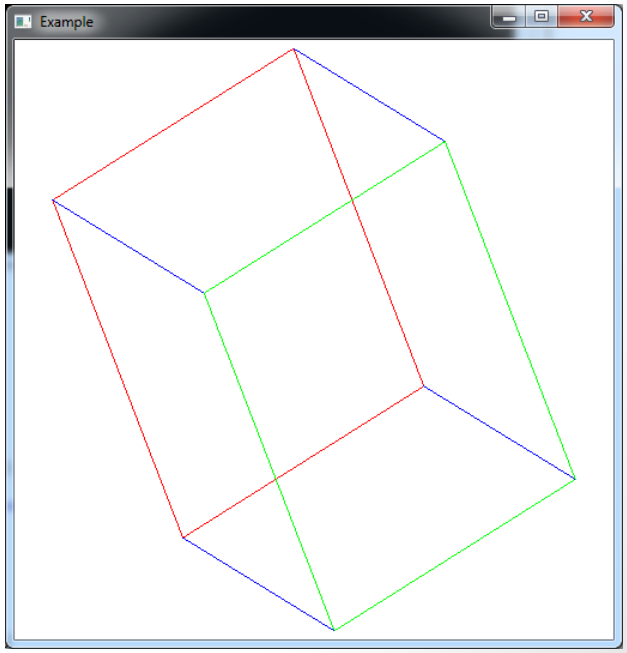


Code example

```
#include <GL/freeglut.h>

void drawBox() {
    glColor3f(1.f, 0.f, 0.f);
    glBegin(GL_LINE_LOOP);
        glVertex3f(-1.f, -1.f, -1.f);
        glVertex3f(1.f, -1.f, -1.f);
        glVertex3f(1.f, 1.f, -1.f);
        glVertex3f(-1.f, 1.f, -1.f);
    glEnd();
    glColor3f(0.f, 1.f, 0.f);
    glBegin(GL_LINE_LOOP);
        glVertex3f(-1.f, -1.f, 1.f);
        glVertex3f(1.f, -1.f, 1.f);
        glVertex3f(1.f, 1.f, 1.f);
        glVertex3f(-1.f, 1.f, 1.f);
    glEnd();
    glColor3f(0.f, 0.f, 1.f);
    glBegin(GL_LINES);
        glVertex3f(-1.f, -1.f, -1.f);
        glVertex3f(-1.f, -1.f, 1.f);
        glVertex3f(1.f, -1.f, -1.f);
        glVertex3f(1.f, -1.f, 1.f);
        glVertex3f(1.f, 1.f, -1.f);
        glVertex3f(1.f, 1.f, 1.f);
        glVertex3f(-1.f, 1.f, -1.f);
        glVertex3f(-1.f, 1.f, 1.f);
    glEnd();
}
```

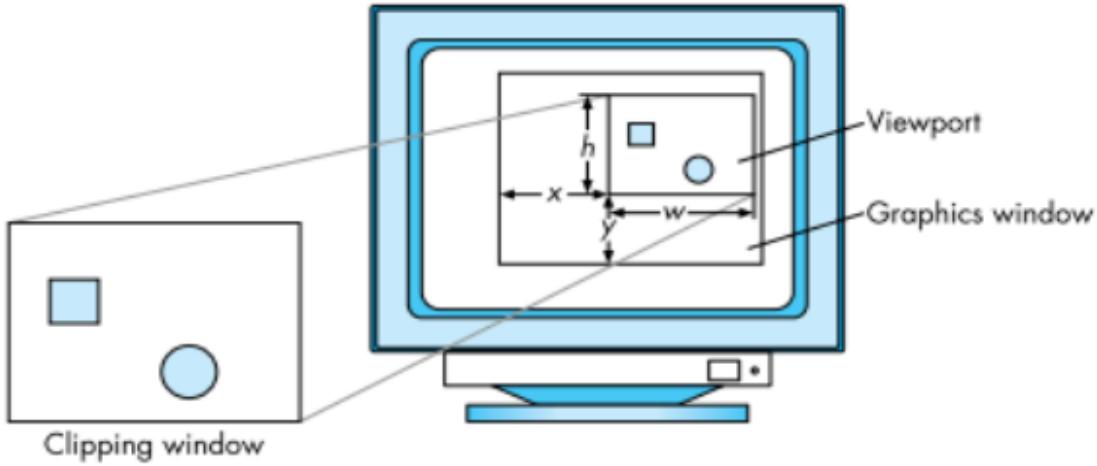
```
void display() {
    glClearColor(1.f, 1.f, 1.f, 1.f);

    glClear(GL_COLOR_BUFFER_BIT);

    glColor3f(0.f,0.f,1.f);

    glPushMatrix();
        glTranslatef(0.f, 0.f, -2.f);
        glRotatef(45.f, 1.f, 1.f, 1.f);
        glScalef(0.5f, 0.7f, 0.5f);
        drawBox();
    glPopMatrix();

    glutSwapBuffers();
}

void reshape(int w, int h) {
    glViewport(0, 0, w, h);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    glOrtho(-1.f, 1.f, -1.f, 1.f, 0.1f, 50.f);
    glMatrixMode(GL_MODELVIEW);
    glLoadIdentity();
}
```

```
int main(int argc, char **argv) {
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB);
    glutInitWindowSize(500, 500);
    glutInitWindowPosition(250, 250);
    glutCreateWindow("Example");

    glutDisplayFunc(display);
    glutReshapeFunc(reshape );

    glutMainLoop();
    return 0;
}
```

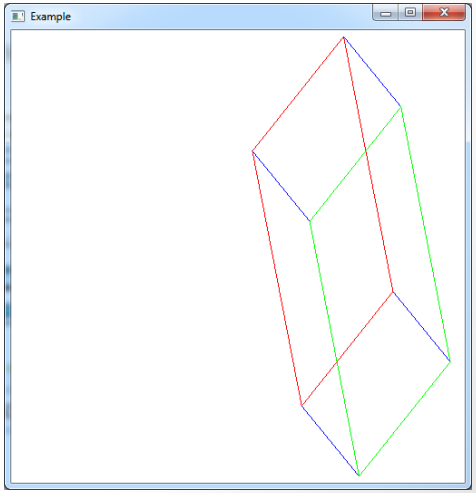


Reshape funtion

- glViewport(GLint x, GLint y, GLsizei w,GLsizei h)



glViewport(250, 0, w-250, h);



Callback functions

- glutDisplayFunc(void (*func)(void));
- glutReshapeFunc(void (*func)(int width, int height));
- glutKeyboardFunc(void (*func)(unsigned char key, int x, int y));
- glutMouseFunc(void (*func)(int button, int state, int x, int y));
- glutMotionFunc(void (*func)(int x, int y));
- glutIdleFunc(void (*func)(void));

Learning OpenGL

- The Red Book
- opengl.org
- nehe.gamedev.net
- lighthouse3d.com/opengl
- Google