Basics of GLUT

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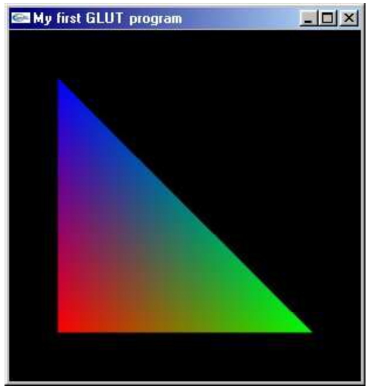

In this tutorial I'll cover the basics of setting up and using OpenGL and GLUT with VC++. I'll take you through initializing your GLUT display, opening a window and displaying a triangle in it. The program you'll learn how to create is a foundation for more complex GLUT projects you might want to undertake in the future.

What is GLUT?

GLUT stands for OpenGL Utility Toolkit. It's an API for OpenGL written by Mark Kilgard. GLUT is very easy to set up and use compared to traditional Win32 OpenGL, making it great for beginners. Because GLUT handles input and window setup, GLUT code is not platform specific, meaning any application you write will run on just about any platform (until you start adding DirectSound code, that is...).

Some preliminary links:

Mark Kilgard's GLUT page
The GLUT FAQ
The online GLUT 3 specification

Getting the GLUT files

You can download the latest version of glut from here.

Once you've downloaded and unzipped the file, copy glut32.dll to your windows\system directory, glut32.lib to your compiler's lib directory and glut.h to your complier's include\gl directory. Now you're ready to roll.

Creating your GLUT project

Start up VC++, then create an empty console application.

Link to glut32.lib, glu32.lib and opengl32.lib in project > settings

The Program

This code includes headers for the libraries we'll be using and declares our functions.

```
#include <windows.h>               //header file for windows
#include <gl\gl.h>                 //header file for openGL
#include <gl\glu.h>                //header file for the openGL utility library
#include <gl\glut.h>               //header file for GLUT

static void redraw(void);          //declarations
int main(int argc, char **argv);
```

The argc variable contains the number of arguments passed to our program, while argv is a pointer to the arguments. We don't need to worry about them particularly, except to pass them to glutInit() so it can process any command line parameters sent to GLUT. The glutInit() function initialises the GLUT framework.

The glutInitDisplayMode function is used to set up the display mode. We'll call it with the following flags:

- **GLUT_RGB** specifies we want an RGB colour buffer in our window
- **GLUT_DOUBLE** specifies we want a double buffer. Double buffering enables us to finish drawing before our image is sent to the screen, preventing flicker.
- **GLUT_DEPTH** specifies we want a depth buffer. The depth buffer ensures that objects near the camera will always be on top of those further away. The output tends to be a bit messy otherwise. While this isn't necessary when we're only drawing a single triangle, it's good practice, so we'll include it anyway.

The glutCreateWindow() function creates the window we're going to be drawing in. glutDisplayFunc() specifies the function we'll use to draw the display, which we'll have to write later. GLUT will call this function whenever the display needs updating.

```
int main(int argc, char **argv)
{
  glutInit(&argc,argv);                                       //initializes the GLUT framework
  glutInitDisplayMode(GLUT_RGB | GLUT_DOUBLE | GLUT_DEPTH);   //sets up the display mode
```

```
  glutCreateWindow("My first GLUT program");                  //creates a window
  glutDisplayFunc(redraw);                                    //specifies our redraw function
```

Next we need to set up the projection matrix. The projection matrix is a 4x4 matrix which is used to translate points from their positions relative to the camera to their positions on the screen. We use it to specify how our scene will be projected. In order to change it we need to call glMatrixMode() with GL_PROJECTION. The gluPerspective() function creates a projection matrix with a perspective transform for us. All we need do is specify the view angle, aspect ratio and the postitions of the near and far clipping planes.

```
  glMatrixMode(GL_PROJECTION);   //changes the current matrix to the projection matrix

  //sets up the projection matrix for a perspective transform
  gluPerspective(45,     //view angle
                 1.0,    //aspect ratio
                 10.0,   //near clip
                 200.0); //far clip
```

When we're done we switch the current matrix to the modelview matrix. The modelview matrix is a 4x4 matrix used to transform points from their actual positions (in world space) into their positions relative to the camera. It's the matrix we use to specify our camera postion and the position of anything we draw. The glutMainLoop() function is the main loop of the GLUT framework and we need to call it next.

```
  glMatrixMode(GL_MODELVIEW);   //changes the current matrix to the modelview matrix

  glutMainLoop();               //the main loop of the GLUT framework

  return 0;
}
```

Next we need to create our redraw() function which will draw our triangle. glClear() called with GL_COLOR_BUFFER_BIT and GL_DEPTH_BUFFER_BIT will clear the colour and depth buffers in our window. We need to do this before we start drawing on it.

```
static void redraw(void)                               //all drawing code goes here
{
  glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);  //clears the colour and depth buffers
```

Now we're almost ready to start drawing. First though we need to store our camera's position ((0,0,0) on the x, y and z axes - the center of our world) with glPushMatrix() and then move it 100 on the Z axis, effectively moving the camera backwards, enabling us to see what we're drawing. Because the modelview matrix specifies where we are drawing relative to the camera, to move the camera we need to translate the matrix by the reverse of the translation we want from the camera, so to move the camera (0,0,100) we translate the modelview matrix (0,0,-100). This has the same effect as moving our triangle (0,0,-100).

```
  glPushMatrix();         //saves the current matrix on the top of the matrix stack
  glTranslatef(0,0,-100); //translates the current matrix 0 in x, 0 in y and -100 in z
```

Now we're going to draw the triangle. In order to do this, we need to call glBegin(GL_TRIANGLES), which tells OpenGL we're going to begin drawing triangles. OpenGL will then treat every group of three vertices as a triangle, and when glEnd() is called it will render the triangle(s) to our window.

Between the glBegin() and glEnd() we need to specify 3 vertices with glVertex3f. The three values specified in the each glVertex3f() call are the vertex's X, Y and Z coordinates in world space. We can also specify a colour for each of the vertices by using glColor3f() before each call to glVertex3f(). The parameters we call glColor3f() with are the red, green and blue elements (from 0 to 1), which make up the colour. OpenGL will then blend the colours across the triangle.

```
  glBegin(GL_TRIANGLES);  //tells OpenGL that we're going to start drawing triangles
  glColor3f(1,0,0);       //sets the current colour to red
  glVertex3f(-30,-30,0);  //specifies the first vertex of our triangle

  glColor3f(0,1,0);       //sets the current colour to green
  glVertex3f(30,-30,0);   //specifies the second vertex of our triangle

  glColor3f(0,0,1);       //sets the current colour to blue
  glVertex3f(-30,30,0);   //specifies the third vertex of our triangle
  glEnd();                //tells OpenGL that we've finished drawing
```

Next we retrieve our saved matrix from the top of the matrix stack with glPopMatrix(), setting the camera's position back to (0,0,0), ready for the next frame. Because we're using double buffering, all drawing has been done on the back buffer (the invisible buffer). Now the frame is completed we call glutSwapBuffers() to swap the front buffer (the visible buffer) and back buffer over, making what we have drawn visible.

```
  glPopMatrix();          //retrieves our saved matrix from the top of the matrix stack
  glutSwapBuffers();      //swaps the front and back buffers
}                         //The end of our program!
```

That's it! The end of our program and this tutorial. Build the program and try it out.

Hopefully with the help of this tutorial you should now be able to build and initialize a GLUT program and draw triangles. If you want to give some feedback on this tutorial or have any questions, please email me.

Code for this tutorial

Discuss this article in the forums

Date this article was posted to GameDev.net: **1/29/2002**
(Note that this date does not necessarily correspond to the date the article was written)

See Also:
GLUT Library
Sweet Snippets