```c
#include <GL/glew.h>
#include <GL/glut.h>
#include <stdio.h>
#include <stdlib.h>
#include <math.h>

#define my_PI 3.141592

static char* vsSource = "#version 130 \n\
in vec4 aPosition; \n\
in vec4 aColor; \n\
flat out vec4 vColor; \n\
// out vec4 vColor; \n\
uniform mat4 urotate;  \n\
uniform mat4 utranslate; \n\
void main(void) { \n\
  gl_Position = urotate*utranslate*aPosition; \n\
  vColor = aColor; \n\
}";

static char* fsSource = "#version 130 \n\
flat in vec4 vColor; \n\
// in vec4 vColor; \n\
void main(void) { \n\
  gl_FragColor = vColor; \n\
}";

GLuint vs = 0;
GLuint fs = 0;
GLuint prog = 0;

char buf[1024];
int DRAW_MODE = 0;
float t = -0.5f;

int num_vertices = 4, num_faces = 4;

/*
GLfloat vertices[] = { // partially clipped out
    0.0, 0.5, -0.8, 1.0, // v0
    -0.5, -0.5, -0.5, 1.0, // v1
    0.5, -0.5, -0.5, 1.0, // v2
    0.0, -0.5, -1.3, 1.0, // v3
};
*/

GLfloat vertices[] = { // at center
    0.0, 0.5, 0.0, 1.0, // v0
    -0.5, -0.5, 0.3, 1.0, // v1
    0.5, -0.5, 0.3, 1.0, // v2
    0.0, -0.5, -0.5, 1.0, // v3
};


GLfloat colors[] = {
    1.0, 0.0, 0.0, 1.0,  // v0 color
```

```
57      0.0, 1.0, 0.0, 1.0,  // v1 color
58      0.0, 0.0, 1.0, 1.0,  // v2 color
59      1.0, 0.0, 1.0, 1.0,  // v3 color
60  };
61
62  GLushort indices[] = {
63      0, 1, 2,  // red
64      1, 0, 3,  // green
65      2, 3, 0,  // blue
66      3, 2, 1,  // purple
67  };
68  void myinit(void) {
69      GLuint status;
70
71      printf("***** Your student number and name *****\n");
72      vs = glCreateShader(GL_VERTEX_SHADER);
73      glShaderSource(vs, 1, &vsSource, NULL);
74      glCompileShader(vs);
75      glGetShaderiv(vs, GL_COMPILE_STATUS, &status);
76      printf("vs compile status = %s\n", (status == GL_TRUE) ? "true" :
          "false");
77      glGetShaderInfoLog(vs, sizeof(buf), NULL, buf);
78      printf("vs log = [%s]\n", buf);
79
80      fs = glCreateShader(GL_FRAGMENT_SHADER);
81      glShaderSource(fs, 1, &fsSource, NULL);
82      glCompileShader(fs);
83      glGetShaderiv(fs, GL_COMPILE_STATUS, &status);
84      printf("fs compile status = %s\n", (status == GL_TRUE) ? "true" :
          "false");
85      glGetShaderInfoLog(fs, sizeof(buf), NULL, buf);
86      printf("fs log = [%s]\n", buf);
87
88      prog = glCreateProgram();
89      glAttachShader(prog, vs);
90      glAttachShader(prog, fs);
91      glLinkProgram(prog);
92      glGetProgramiv(prog, GL_LINK_STATUS, &status);
93      printf("program link status = %s\n", (status == GL_TRUE) ? "true" :
          "false");
94      glGetProgramInfoLog(prog, sizeof(buf), NULL, buf);
95      printf("link log = [%s]\n", buf);
96      glValidateProgram(prog);
97      glGetProgramiv(prog, GL_VALIDATE_STATUS, &status);
98      printf("program validate status = %s\n", (status == GL_TRUE) ? "true" :
          "false");
99      glGetProgramInfoLog(prog, sizeof(buf), NULL, buf);
100     printf("validate log = [%s]\n", buf);
101     glUseProgram(prog);
102
103     GLuint loc;
104     GLuint vbo[1];
105     // using vertex buffer object
106     glGenBuffers(1, vbo);
107     glBindBuffer(GL_ARRAY_BUFFER, vbo[0]);
108     glBufferData(GL_ARRAY_BUFFER, 2 * num_vertices * 4 * sizeof(GLfloat),
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        NULL, GL_STATIC_DRAW);
109     glBufferSubData(GL_ARRAY_BUFFER, 0, num_vertices * 4 * sizeof(GLfloat),
        vertices);
110     glBufferSubData(GL_ARRAY_BUFFER, num_vertices * 4 * sizeof(GLfloat),
        num_vertices * 4 * sizeof(GLfloat),
111       colors);
112
113     loc = glGetAttribLocation(prog, "aPosition");
114     glEnableVertexAttribArray(loc);
115     glVertexAttribPointer(loc, 4, GL_FLOAT, GL_FALSE, 0, (GLvoid *)0);
116
117     loc = glGetAttribLocation(prog, "aColor");
118     glEnableVertexAttribArray(loc);
119     glVertexAttribPointer(loc, 4, GL_FLOAT, GL_FALSE, 0, (GLvoid *)
        (num_vertices * 4 * sizeof(GLfloat)));
120
121     glProvokingVertex(GL_FIRST_VERTEX_CONVENTION);
122     glEnable(GL_DEPTH_TEST);
123     //  glPolygonMode(GL_FRONT_AND_BACK, GL_LINE);
124     glPolygonMode(GL_FRONT_AND_BACK, GL_FILL);
125
126 }
127
128 void mykeyboard(unsigned char key, int x, int y) {
129     switch (key) {
130     case 27: // ESCAPE
131         exit(0);
132         break;
133     }
134 }
135
136 void myidle(void) {
137     t += 0.0001f;
138
139
140     // redisplay
141     glutPostRedisplay();
142 }
143
144 GLfloat m[16];
145
146 void mydisplay(void) {
147     GLuint loc;
148     glClearColor(0.7f, 0.7f, 0.7f, 1.0f); // gray
149     glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
150
151     //Ry(0) -> R(my_PI/2.0)
152     // t = 0.0;
153     t = my_PI/2.0;
154     m[0] = cos(t);      m[4] = 0.0;     m[8] = sin(t);     m[12] = 0.0;
155     m[1] = 0.0;         m[5] = 1.0;     m[9] = 0.0;        m[13] = 0.0;
156     m[2] = -sin(t);     m[6] = 0.0;     m[10] = cos(t);    m[14] = 0.0;
157     m[3] = 0.0;         m[7] = 0.0;     m[11] = 0.0;       m[15] = 1.0;
158
159     loc = glGetUniformLocation(prog, "urotate");
160     glUniformMatrix4fv(loc, 1, GL_FALSE, m);
```

```
161
162     // T(0,0,0)  -> T(-3, 0, 0)   -> T(-1, 0, 0)
163     m[0] = 1.0;    m[4] = 0.0;    m[8] = 0.0;    m[12] = -1.0;
164     m[1] = 0.0;    m[5] = 1.0;    m[9] = 0.0;    m[13] = 0.0;
165     m[2] = 0.0;    m[6] = 0.0;    m[10] = 1.0;   m[14] = 0.0;
166     m[3] = 0.0;    m[7] = 0.0;    m[11] = 0.0;   m[15] = 1.0;
167
168     loc = glGetUniformLocation(prog, "utranslate");
169     glUniformMatrix4fv(loc, 1, GL_FALSE, m);
170
171     glDrawElements(GL_TRIANGLES, num_faces * 3, GL_UNSIGNED_SHORT, indices);
172     glFlush();
173
174     glutSwapBuffers();
175 }
176
177
178 int main(int argc, char* argv[]) {
179     glutInit(&argc, argv);
180     glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
181 //  glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB);
182     glutInitWindowSize(500, 500);
183     glutInitWindowPosition(0, 0);
184     glutCreateWindow("*** Your Student Number and Name ***");
185     glutDisplayFunc(mydisplay);
186     glutIdleFunc(myidle);
187     glutKeyboardFunc(mykeyboard);
188     glewInit();
189     myinit();
190     glutMainLoop();
191     return 0;
192 }
193
```