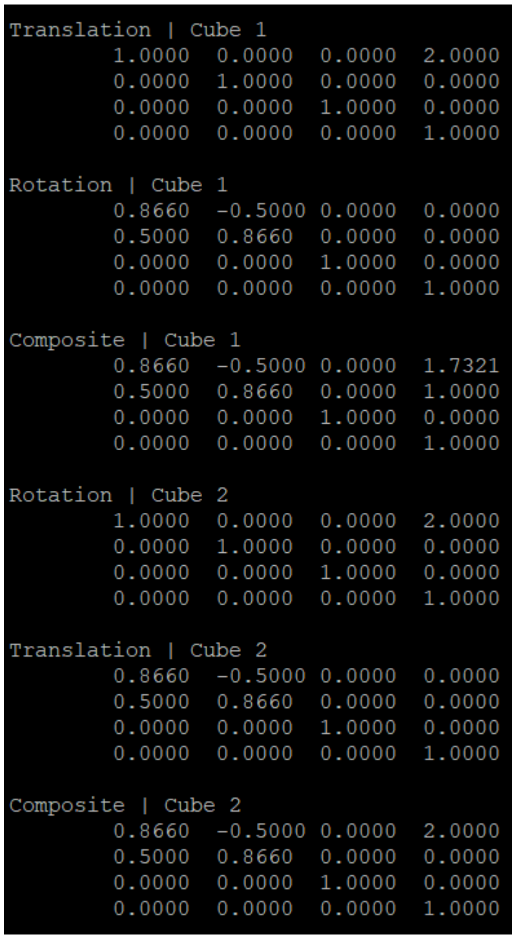
CSE 4200 Lab 9 – Spencer Wallace

Summary: All parts completed successfully. For problem one I was able to modify Dr. Yu's program to print the different matrices after applying transformations and rotations. For problem two I was able to draw the wire cube and view it using different values for the look at function. I was also able to complete the extra credit using an idle function which would transform and rotate the earth and sun. Because of this I am giving myself a full score as well as the extra credit, 40/20.

Problem 1

Output



```
Translation | Cube 1
        1.0000  0.0000  0.0000  2.0000
        0.0000  1.0000  0.0000  0.0000
        0.0000  0.0000  1.0000  0.0000
        0.0000  0.0000  0.0000  1.0000

Rotation | Cube 1
        0.8660  -0.5000 0.0000  0.0000
        0.5000  0.8660  0.0000  0.0000
        0.0000  0.0000  1.0000  0.0000
        0.0000  0.0000  0.0000  1.0000

Composite | Cube 1
        0.8660  -0.5000 0.0000  1.7321
        0.5000  0.8660  0.0000  1.0000
        0.0000  0.0000  1.0000  0.0000
        0.0000  0.0000  0.0000  1.0000

Rotation | Cube 2
        1.0000  0.0000  0.0000  2.0000
        0.0000  1.0000  0.0000  0.0000
        0.0000  0.0000  1.0000  0.0000
        0.0000  0.0000  0.0000  1.0000

Translation | Cube 2
        0.8660  -0.5000 0.0000  0.0000
        0.5000  0.8660  0.0000  0.0000
        0.0000  0.0000  1.0000  0.0000
        0.0000  0.0000  0.0000  1.0000

Composite | Cube 2
        0.8660  -0.5000 0.0000  2.0000
        0.5000  0.8660  0.0000  0.0000
        0.0000  0.0000  1.0000  0.0000
        0.0000  0.0000  0.0000  1.0000
```

Code

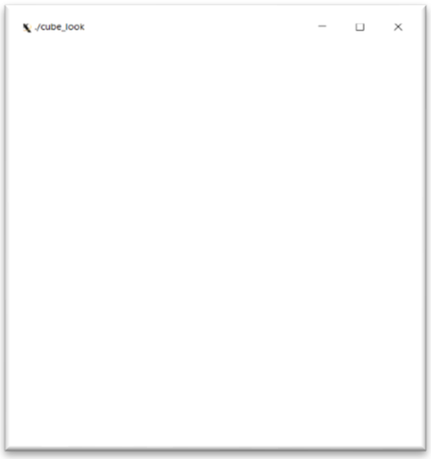
```
#include <GL/glut.h>

#include <stdlib.h>

#include <iostream>

#include <stdio.h>


using namespace std;


void init(void)

{

  glClearColor(1.0, 1.0, 1.0, 0.0);

  glShadeModel(GL_FLAT);

}


//print the transformation matrix

template<class T>

void print_mat(T m[][4])

{

  cout.precision(4);

  cout << fixed;

  for (int i = 0; i < 4; ++i) {

    cout << "\t";

    for (int j = 0; j < 4; ++j)

      cout << m[j][i] << "\t";

    cout << endl;

  }

  cout << endl;
```

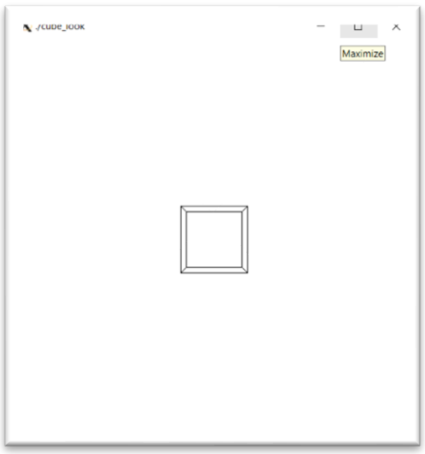
```
}

void display(void)
{
  float p[4][4];
  double pd[4][4];
  double pdc[4][4];
  glClear(GL_COLOR_BUFFER_BIT);
  glColor3f(0.0, 0.0, 0.0); //black color
  glLoadIdentity(); // clear the matrix
  glGetDoublev(GL_MODELVIEW_MATRIX, &pdc[0][0]);
  cout << "Matrix:" << endl;
  print_mat(pdc);

  glLoadIdentity();
  glTranslatef(2.0, 0, 0); //move 2 unit on x axis
  glGetFloatv(GL_MODELVIEW_MATRIX, &p[0][0]);
  cout << "Translation | Cube 1" << endl;
  print_mat(p);
  glLoadIdentity();
  glRotatef(30, 0, 0, 1); // rotate 30 degrees from z axis
  glGetDoublev(GL_MODELVIEW_MATRIX, &pd[0][0]);
  cout << "Rotation | Cube 1" << endl;
  print_mat(pd);
  glLoadIdentity();
  glRotatef(30, 0, 0, 1); // rotate 30 degrees from z axis
  glTranslatef(2.0, 0, 0); //move 2 unit on x axis
  glGetDoublev(GL_MODELVIEW_MATRIX, &pd[0][0]);
  cout << "Composite | Cube 1" << endl;
```

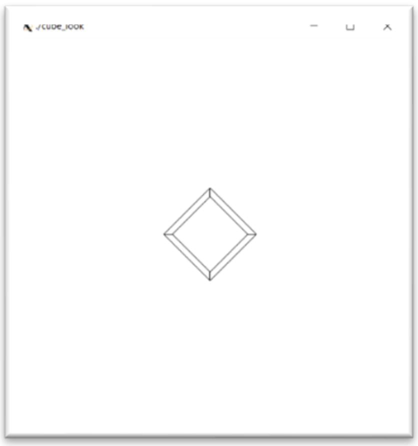
```
 print_mat(pd);


 glLoadIdentity();
 glRotatef(30, 0, 0, 1); // rotate 30 degrees from z axis
 glGetDoublev(GL_MODELVIEW_MATRIX, &pd[0][0]);
 cout << "Rotation | Cube 2" << endl;
 print_mat(p);
 glLoadIdentity();
 glTranslatef(2.0, 0, 0); //move 2 unit on x axis
 glGetFloatv(GL_MODELVIEW_MATRIX, &p[0][0]);
 cout << "Translation | Cube 2" << endl;
 print_mat(pd);
 glLoadIdentity();
 glTranslatef(2.0, 0, 0); //move 2 unit on x axis
 glRotatef(30, 0, 0, 1); // rotate 30 degrees from z axis
 glGetDoublev(GL_MODELVIEW_MATRIX, &pd[0][0]);
 cout << "Composite | Cube 2" << endl;
 print_mat(pd);



 glFlush();
}

void keyboard(unsigned char key, int x, int y)
{
 switch (key) {
 case 27:
  exit(0);
  break;
 }
}

int main(int argc, char** argv)
{
 glutInit(&argc, argv);
 glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
 glutInitWindowSize(500, 500);
 glutInitWindowPosition(100, 100);
 glutCreateWindow(argv[0]);
 init();
 glutDisplayFunc(display);
 glutKeyboardFunc(keyboard);
 glutMainLoop();
 return 0;
}
```

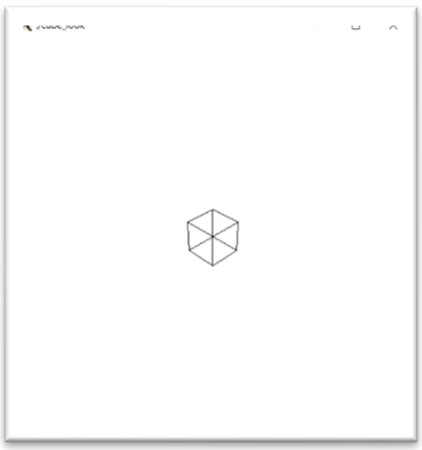
Problem 2

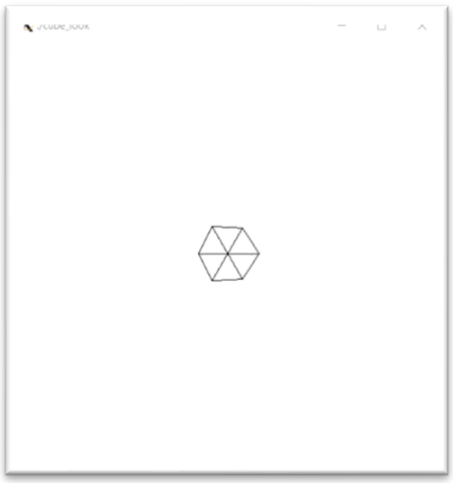
Output











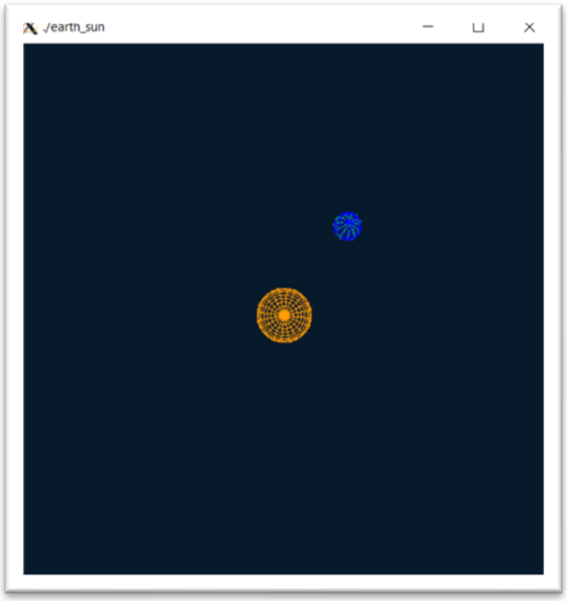
Code

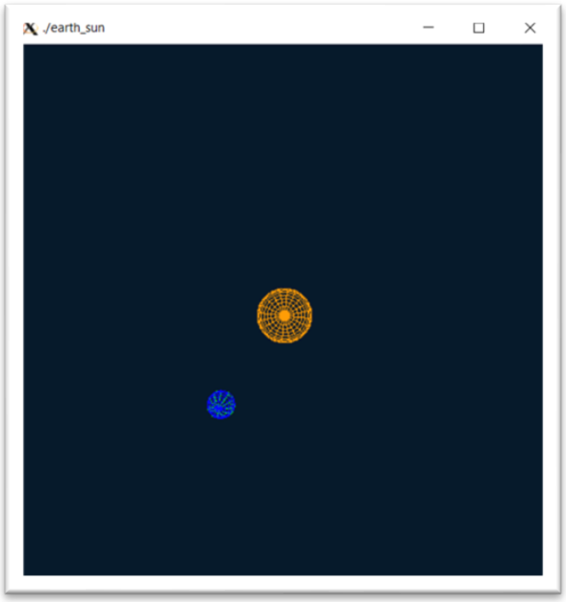
```
#include <GL/glut.h>

#include <stdlib.h>

#include <iostream>

#include <stdio.h>


using namespace std;

int lookVersion = 0;


void init(void)

{

  glClearColor(1.0, 1.0, 1.0, 0.0);

  glShadeModel(GL_FLAT);

}


void reshape(int w, int h)

{

  glViewport(0, 0, (GLsizei)w, (GLsizei)h);

  glMatrixMode(GL_PROJECTION);

  glLoadIdentity();

  glFrustum(-1.0, 1.0, -1.0, 1.0, 1.5, 20.0);

  glMatrixMode(GL_MODELVIEW);

}


void display(void)

{

  glClear(GL_COLOR_BUFFER_BIT);

  glColor3f(0.0, 0.0, 0.0); //black color
  glLoadIdentity(); // clear the matrix

  switch(lookVersion)
  {
  case 0: gluLookAt(5.0, 5.0, 5.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0); //see nothing
          break;
  case 1: gluLookAt(0.0, 0.0, 5.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0); //see cube
          break;
  case 2: gluLookAt(0.0, 0.0, 5.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0); //see cube
          break;
  case 3: gluLookAt(5.0, 5.0, 5.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0); //see cube
          break;
  case 4: gluLookAt(5.0, 5.0, 5.0, 0.0, 0.0, 0.0, 1.0, 0.5, 0.0); //see cube
          break;
  default: cout << "Invalid value for cube to display."; return;
  }

  glutWireCube(1.0);

  glFlush();
}

void keyboard(unsigned char key, int x, int y)
{
  switch (key) {
  case 27:
    exit(0);
    break;
  }
```

```
}

int main(int argc, char** argv)
{
  if(argc > 1){
        lookVersion = int(*argv[1])-48;
        cout << argv[1] << endl;
  }
  glutInit(&argc, argv);
  glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
  glutInitWindowSize(500, 500);
  glutInitWindowPosition(100, 100);
  glutCreateWindow(argv[0]);
  init();
  glutDisplayFunc(display);
  glutReshapeFunc(reshape);
  glutKeyboardFunc(keyboard);
  glutMainLoop();
  return 0;
}
```

Extra Credit

Output





Code

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

#include <stdlib.h>

#include <iostream>

#include <stdio.h>


void init()

{

  glShadeModel(GL_FLAT);

  glClearColor(0.0, 0.08, 0.15, 0.0); //bluish black

}


void reshape(int w, int h)

{
  glViewport(0, 0, (GLsizei)w, (GLsizei)h);
  glMatrixMode(GL_PROJECTION);
  glLoadIdentity();
  glFrustum(-1.0, 1.0, -1.0, 1.0, 1.0, 100.0);
  glMatrixMode(GL_MODELVIEW);
}

float earth = 1.0;
float sun = 1.0;

void display(void)
{
  glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
  glMatrixMode(GL_MODELVIEW);
  glLoadIdentity();
  glTranslatef(0.0, 0.0, -100.0);
  glRotatef(sun, 0.0, 0.0, 1.0);
  glColor3f(1.0, 0.6, 0.0);
  glutWireSphere(10.0, 20, 20);
  glColor3f(0.0, 1.0, 0.0); //green earth wireframe
  glRotatef(earth, 0.0, 0.0, 1.0);
  glTranslatef(40.0, 0.0, 0.0);
  glutWireSphere(5.0, 12, 12);
  glColor3f(0.0, 0.0, 1.0); //blue earth wireframe
  glRotatef(earth, 0.0, 0.0, 0.9);
  glutWireSphere(5.0, 12, 12);

  glFlush();
  glutSwapBuffers();
```

```
}

void spin(void)
{
  earth += 2.0;
  sun += 0.5;
  display();
}

void keyboard(unsigned char key, int x, int y)
{
  switch (key) {
  case 27:
    exit(0);
    break;
  }
}

int main(int argc, char** argv)
{
  glutInit(&argc, argv);
  glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB );
  glutInitWindowPosition(100, 100);
  glutInitWindowSize(500, 500);
  glutCreateWindow(argv[0]);
  glutReshapeFunc(reshape);
  glutDisplayFunc(display);
  glutKeyboardFunc(keyboard);
  glutIdleFunc(spin);
  init();

  glutMainLoop();

  return 0;

}
```