Question Q1–1: (Solution, p 2) How is it that nearly *any* light frequency distribution can be represented exactly using a combination of only three particular light frequencies (red, green, blue)?

Question Q1–2: (Solution, p 2) In terms of the geometric properties of two vectors $\mathbf{a}$ and $\mathbf{b}$, what does the dot product of the vectors compute?

Question Q1–3: (Solution, p 2)

When the program at left using OpenGL is run, what will appear in the below window?


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

void drawPolygon() {
    glBegin(GL_POLYGON);
        glVertex2f(-1.0, 0.0);
        glVertex2f( 1.0, 0.0);
        glVertex2f( 0.0, 1.732);
    glEnd();
}

void draw() {
    glClear(GL_COLOR_BUFFER_BIT);

    glColor3f(1.0, 0.0, 0.0);
    drawPolygon();
    glColor3f(0.0, 0.0, 1.0);
    glTranslatef(0.0, 1.155, 0.0);
    glScalef(-1.0, -1.0, -1.0);
    drawPolygon();

    glFlush();
}

void main(int argc, char **argv) {
    glutInit(&argc, argv); glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(200, 200); glutCreateWindow("Mystery");

    glClearColor(1.0, 1.0, 1.0, 0.0);
    glMatrixMode(GL_PROJECTION);
    gluOrtho2D(-1, 1, -0.5, 1.5);

    glutDisplayFunc(draw);
    glutMainLoop();
}
```

Question Q1–4: (Solution, p 2) Suppose I have three points A, B, and C. Algebraically, how might I define the collection of points inside the triangle ABC? (Hint: The collection of convex combinations of the points defines the triangle.)

Question Q1–5: (Solution, p 2) Define the term *affine transformation*.

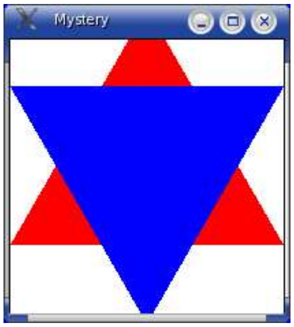
Question Q1–6: (Solution, p 2) Give a single matrix that represents scaling all coordinates by a factor of $1/2$ and then translating the coordinates 2 units along the x axis. Thus, $(2, 2, 2)$ should be transformed to $(3, 1, 1)$ by your matrix.

Question Q1–7: (Solution, p 2) Draw the graphics pipeline as discussed in class.

Solution Q1–1: (Question, p 1) The human eye contains three types of cones, and our perception of a light frequency distribution is based solely on how that combination stimulates those three cone types. A combination of red, green, and blue that stimulates those cones in the same way is indistinguishible from the original light frequency distribution. [Of course, this combination will have a very different frequency distribution, but as far as our perception is concerned, the only factor that matters is how it stimulates the different cone types. A color-blind person, incidentally, typically lacks one cone type, and so only only two light frequencies would have to be combined to achieve the same effect. Chickens, on the other hand, with nine cone types, would find that RGB monitors can represent only a very limited spectrum of colors.]

Solution Q1–2: (Question, p 1) It computes the cosine of the angle between the two vectors, multiplied by $\mathbf{a}$'s length and also $\mathbf{b}$'s length.

Solution Q1–3: (Question, p 1)



Solution Q1–4: (Question, p 1) Every point in the triangle is of the form $uA + vB + wC$ for some three *positive* scalars u, v, and w such that $u+v+w = 1$. [Without the *positive* qualifier, we'd have the collection of all *affine combinations*, and it would include *all* the points on the plane containing A, B, and C.]

Solution Q1–5: (Question, p 1) An affine transformation is one in which each point P is transformed to a point whose coordinates are computed as a linear combination of the coordinates of P, plus possibly some constant. (Equivalently, an affine transformation is one that can be represented as a matrix if we use homogeneous coordinates.)

Solution Q1–6: (Question, p 1)

$$\begin{pmatrix} 0.5 & 0 & 0 & 2 \\ 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Solution Q1–7: (Question, p 1)