I. Properties of Lights

A light’s position (when \( w \neq 0 \)) or direction (when \( w = 0 \)) is specified by:

```c
float pos[4] = \{ x, y, z, w \};
glLightfv(GL_LIGHTi, GL_POSITION, pos);
```

“GL_LIGHTi“ should be one of “GL_LIGHT0“ through “GL_LIGHT7”

A light’s intensities \( I_{in}^{r}, I_{in}^{g}, I_{in}^{b} \) are specified by:

```c
float color[4] = \{ r, g, b, a \};
glLightfv(GL_LIGHTi, \{ GL_AMBIENT \}, color);
```

(The “a” (alpha) component of the color can be set always to 1 in the course.)

Global ambient light \( I_{in,global}^{r}, I_{in,global}^{g}, I_{in,global}^{b} \) is specified by

```c
float color[4] = \{ r, g, b, a \};
glLightModelfv(GL_LIGHT_MODEL_AMBIENT, color);
```

Reminder: Lights themselves are not visible in in the rendered scene; their effect is (only) to illuminate objects in the scene.
II. Properties of Materials and Vertices

Material color properties $\rho_a, \rho_d, \rho_s, I_e$ are set by:

```c
float color[4] = {r, g, b, a };

glMaterialfv(
  GL_FRONT, GL_DIFFUSE, GL_AMBIENT, GL_AMBIENT_AND_DIFFUSE, color);
```

The specular exponent (shininess) is set by:

```c

```

The vertex normal and vertex position are set by:

```c

Generally, one sets a fixed material color and shininess for a surface, and then gives `glNormal3f` and `glVertex3f` — in that order — for each vertex.

For this course, always use `glEnable(GL_NORMALIZE);`
III. Other useful commands for lighting

Enable Phong light:

```gl
glEnable(GL_LIGHTING);
```

Enable/disable (turn off and on) a light:

```gl
glEnable(GL_LIGHTi); // 'i' should be 0, 1, 2, 3, 4, 5, 6, or 7
```

Turn off and on Gouraud (smooth) shading

```gl
glShadeModel(GL_FLAT);
glShadeModel(GL_SMOOTH);
```

To apply Phong lighting to back faces:

```gl
glLightModeli(GL_LIGHT_MODEL_TWO_SIDE, GL_TRUE);
```

To turn on/off the use of the halfway vector $h$:

```gl
glLightModeli(GL_LIGHT_MODEL_LOCAL_VIEWER, GL_TRUE);
glLightModeli(GL_LIGHT_MODEL_LOCAL_VIEWER, GL_FALSE);
```

To use non-unit normal vectors, and non rigid ModelView transformations, use

```gl
glEnable( GL_NORMALIZE );
```

For other options for attenuation, spotlights and normalization, see the textbook page 86-87.