1. Why is it customary to use the same specular exponent for all wavelengths? What might a specular highlight look like if different wavelengths had different specular exponents?

2. Let \( x = \langle 0, 0 \rangle, \ y = \langle 4, 0 \rangle, \ z = \langle 5, 3 \rangle, \) and \( w = \langle 0, 2 \rangle, \) as shown in the figure. For each of the following values of \( \alpha \) and \( \beta, \) what point is obtained by bilinear interpolation? Draw a copy of the quadrilateral, and show the approximate locations of your answers. (The value \( \alpha \) gives the right-to-left direction; \( \beta \) the bottom-to-top direction.)
   a. \( \alpha = 1 \) and \( \beta = 0. \)
   b. \( \alpha = \frac{1}{3} \) and \( \beta = 1. \)
   c. \( \alpha = \frac{1}{2} \) and \( \beta = \frac{1}{4}. \)
   d. \( \alpha = \frac{2}{3} \) and \( \beta = \frac{1}{3}. \)

3. A function \( g : [0,1] \times [0,1] \rightarrow \mathbb{R}^3 \) is defined by setting \( g(\langle 0,0 \rangle) = \langle 2,0,0 \rangle, \) \( g(\langle 1,0 \rangle) = \langle 0,1,0 \rangle, \) \( g(\langle 0,1 \rangle) = \langle 0,2,4 \rangle, \) \( g(\langle 1,1 \rangle) = \langle 2,2,0 \rangle, \) and then using bilinear interpolation to extend the domain of \( g \) to the square \([0,1] \times [0,1].\) What is \( g(\frac{1}{4},0)? \) \( g(\frac{1}{4},1)? \) \( g(\frac{1}{4}, \frac{1}{2})? \)

4. Suppose a surface patch in \( \mathbb{R}^3 \) is defined by bilinearly interpolating from four vertices. Derive the following formulas for the partial derivatives of \( u: \)

\[
\frac{\partial u}{\partial \alpha} = (1 - \beta)(y - x) + \beta(z - w)
\]

\[
\frac{\partial u}{\partial \beta} = (1 - \alpha)(w - x) + \alpha(z - y).
\]

In addition, give the formula for the normal vector to the patch at a point \( u = u(\alpha, \beta). \)
5. This problem is about points in \( \mathbb{R}^2 \), and their homogeneous representations; and how they act under linear coordinates. Let

\[ x = \langle 0, 0, 2 \rangle \quad \text{and} \quad y = \langle 4, 8, 4 \rangle \]

be homogeneous representations for the following two vectors in \( \mathbb{R}^2 \):

\[ a = \langle 0, 0 \rangle \quad \text{and} \quad b = \langle 1, 2 \rangle. \]

(a) What point \( u \) in \( \mathbb{R}^2 \) is equal to \( \frac{1}{4}a + \frac{3}{4}b \)?

(b) What point \( w \) in \( \mathbb{R}^2 \) is represented by (in homogeneous representation)

\[ \frac{1}{7}x + \frac{2}{7}y \]?

(c) Give values \( \alpha \) and \( \beta \) so that \( \alpha x + \beta y \) is an affine combination giving a homogeneous representation of the point \( u \) calculated in part (a).