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**Final**

1. Sketch the geometry (vectors from a vertex) of the Phong lighting model.
2. Which are the three types of light sources in the Phong lighting model? Which are viewer dependent?
3. State Lambert's law.
4. Fig. 1 shows four 3D points. Using bilinear interpolation, sketch where the domain point corresponding to  $(u, v) = (0.33, 0.66)$  is mapped to.

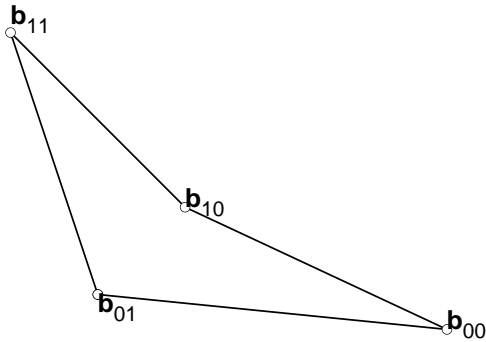


Figure 1: Bilinear interpolation.

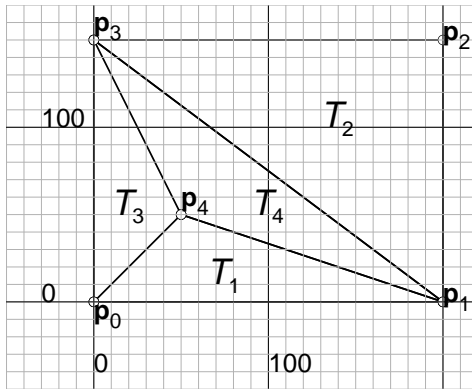


Figure 2: A triangulation.

5. Let the input polygon to Chaikin's algorithm be a triangle. After four iterations (the initial triangle counting as the 0<sup>th</sup> iteration), you will have a refined polygon. How many vertices does it have?

6. Figure 2 shows a triangulation. Points are labeled as  $\mathbf{p}_i$ , Triangles as  $T_i$ . Write down the corresponding off-file (ignore  $z$ -coordinates).

7. Let  $\mathbf{p}$  be a point on an object and let  $\mathbf{n}$  be the corresponding normal. Let  $\mathbf{e}$  be the eye position of the viewer. What condition do  $\mathbf{p}$ ,  $\mathbf{n}$ , and  $\mathbf{e}$  have to satisfy such that  $\mathbf{p}$  is on a silhouette?

8. What is the convex hull of a tetrahedron?

9. What is “cel shading”?

10. Let a texture be defined by the letter “X” drawn into a square. Draw schematically how the RGB structure of the mipmap levels are stored using three levels of mipmap depth.