Shading Algorithms

- Given the lights in the scene

- How to compute the color at a given point on a triangle

- Three main types
  - Flat shading.
  - Gouraud shading.
  - Phong shading.

- These roughly correspond to:
  - Per-polygon shading.
  - Per-vertex shading.
  - Per-pixel shading.
Flat Shading

- Applied to piecewise linear polygonal models
- Simple surface lighting approximated over polygons
- Illumination value depends only on polygon normal $\Rightarrow$ each polygon is colored with a uniform intensity
- Looks non-smooth (worsened by Mach band effect)
Normal per Vertex

If a polyhedron is an approximation of smooth surface:
- Assign to each vertex the normal of original surface at that point
- If surface is not available use estimated normal (e.g. average of neighboring faces).
Gouraud Shading

- Compute illumination intensity at vertices using normals
- Linearly interpolate intensity over polygon interior
Gouraud Shading

Linearly interpolate lighting intensities at the vertices over interior pixels of the polygon, in the image plane.

Question: Can Gouraud shading support specular lighting?
Phong Shading

- Interpolate (at the vertices in image space) normal vectors instead of illumination intensities.
- Apply the illumination equation for each interior pixel with its own (interpolated) normal.

\[ \alpha N_1 + (1 - \alpha) N_2 \]

\[ cN_1 + dN_2 + eN_3 \quad (c + d + e = 1) \]

\[ b N_1 + (1 - b) N_3 \]
Comparison

Flat | Gouraud | Phong

[Images of three spheres representing different lighting techniques: Flat, Gouraud, and Phong]
Comparison