10 – surface shading

12 - texture maping after this

Illumination and Shading

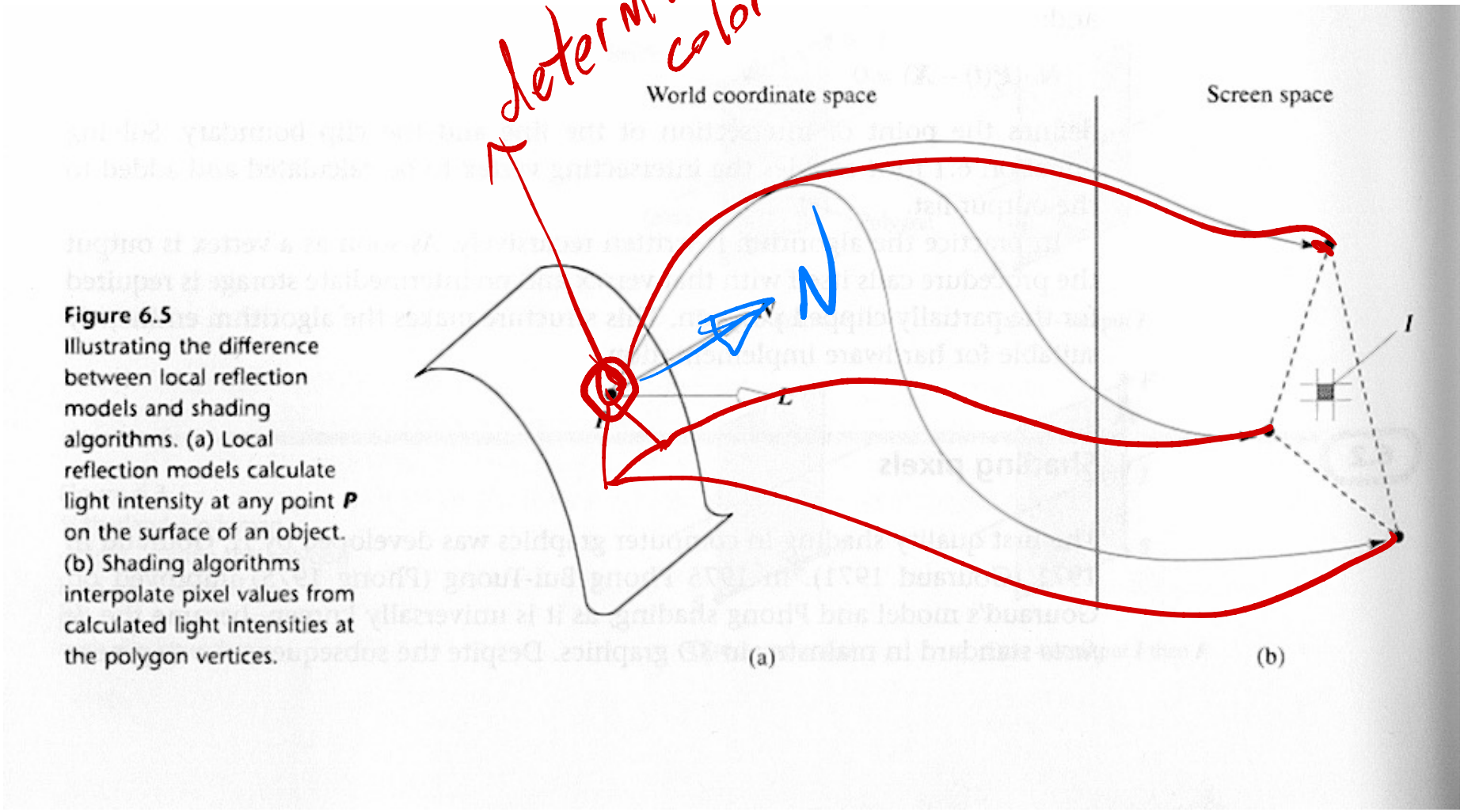


Figure 6.5
Illustrating the difference between local reflection models and shading algorithms. (a) Local reflection models calculate light intensity at any point ***P*** on the surface of an object. (b) Shading algorithms interpolate pixel values from calculated light intensities at the polygon vertices.

Illumination and Shading

computed I ← Illumination for a point

- Illumination Models
  - Ambient
  - Diffuse
  - Attenuation
  - Specular Reflection
- Interpolated Shading Models
  - Flat, Gouraud, Phong
  - Problems

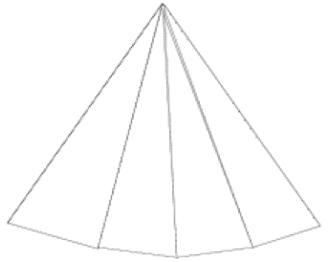
Shading Models

Surface color in this model = ambient + diffuse + specular

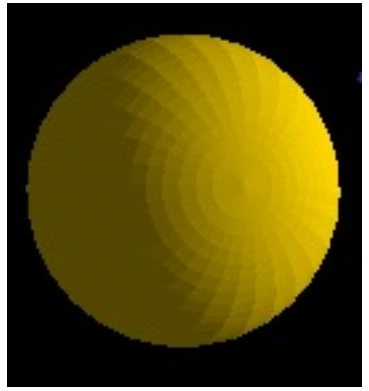
To shade triangles:

1) Per Triangle — 1 color
2) Per Vertex — 1 color per vertex
3) Per Pixel — actually compute I for each pixel

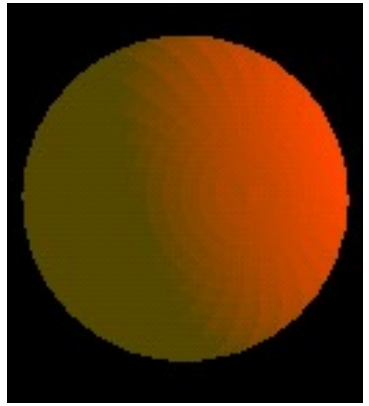
Shading Models: Per Triangle (Flat Shading)



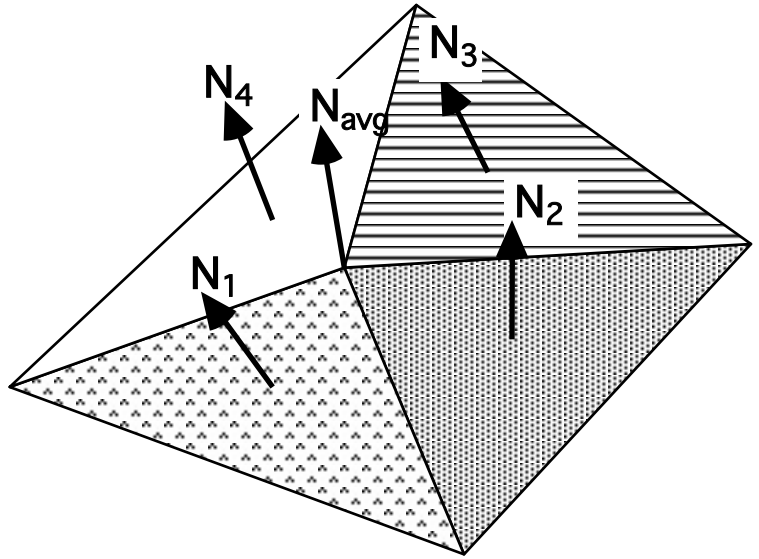
- Compute one color for polygon
  - Use polygon normal in lighting eqs.
- Every pixel is assigned same color



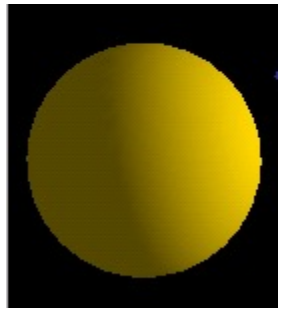
- Fast and simple
- Shade of polygons independent

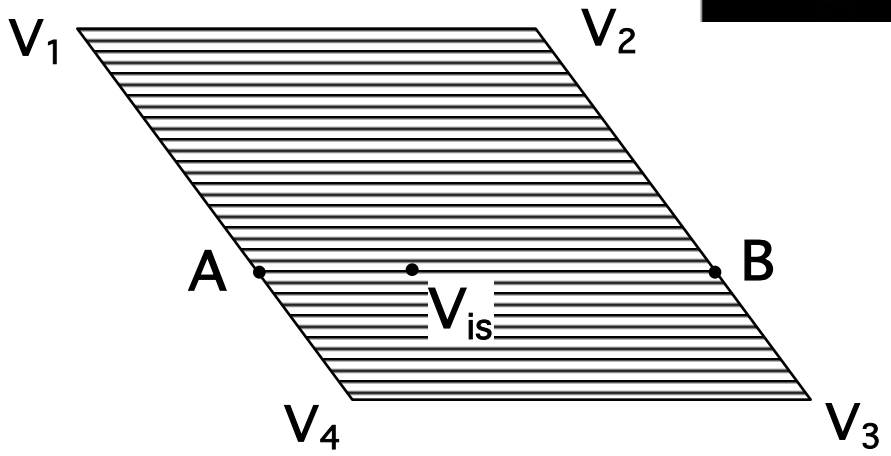


Shading Models: Per Vertex (Gouraud Shading)

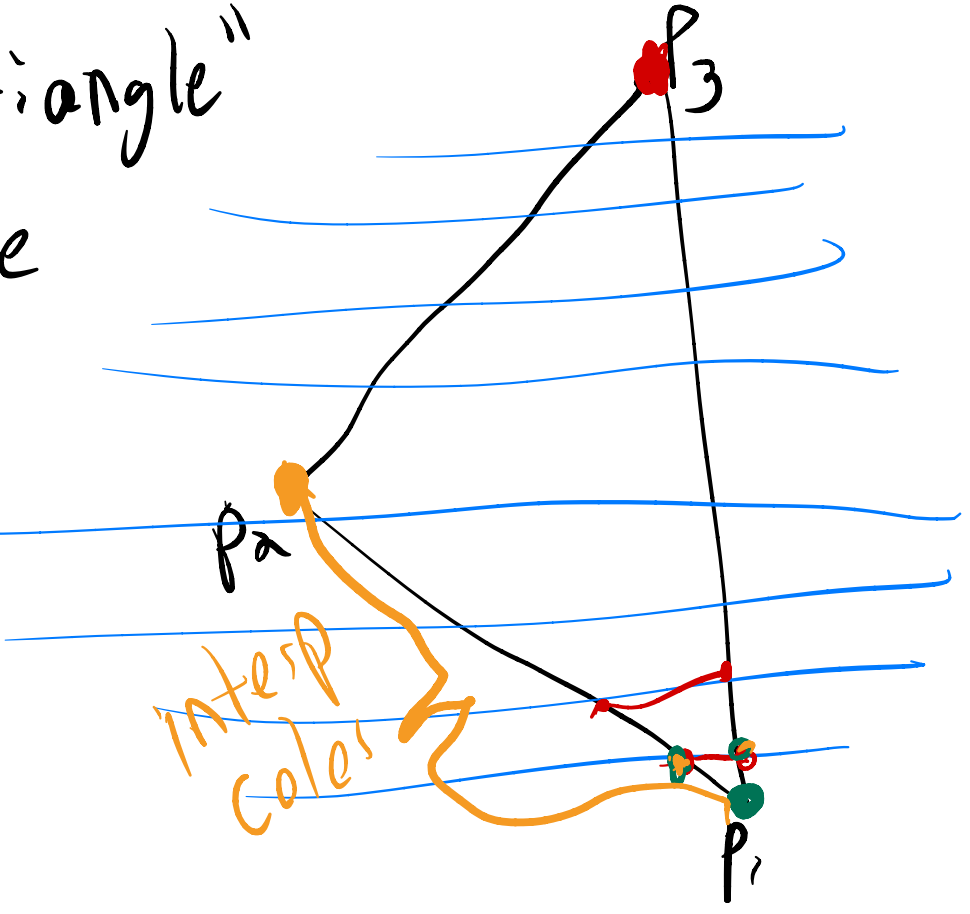


- Compute vertex normals
  - Average normals of abutting polygons
- Use vertex normal in lighting eqs.
- Linearly interpolate vertex intensities
  - Along edges
  - Along scan lines





for a "typical triangle"
3 colors will be
variation of
same color



Gouraud Shading

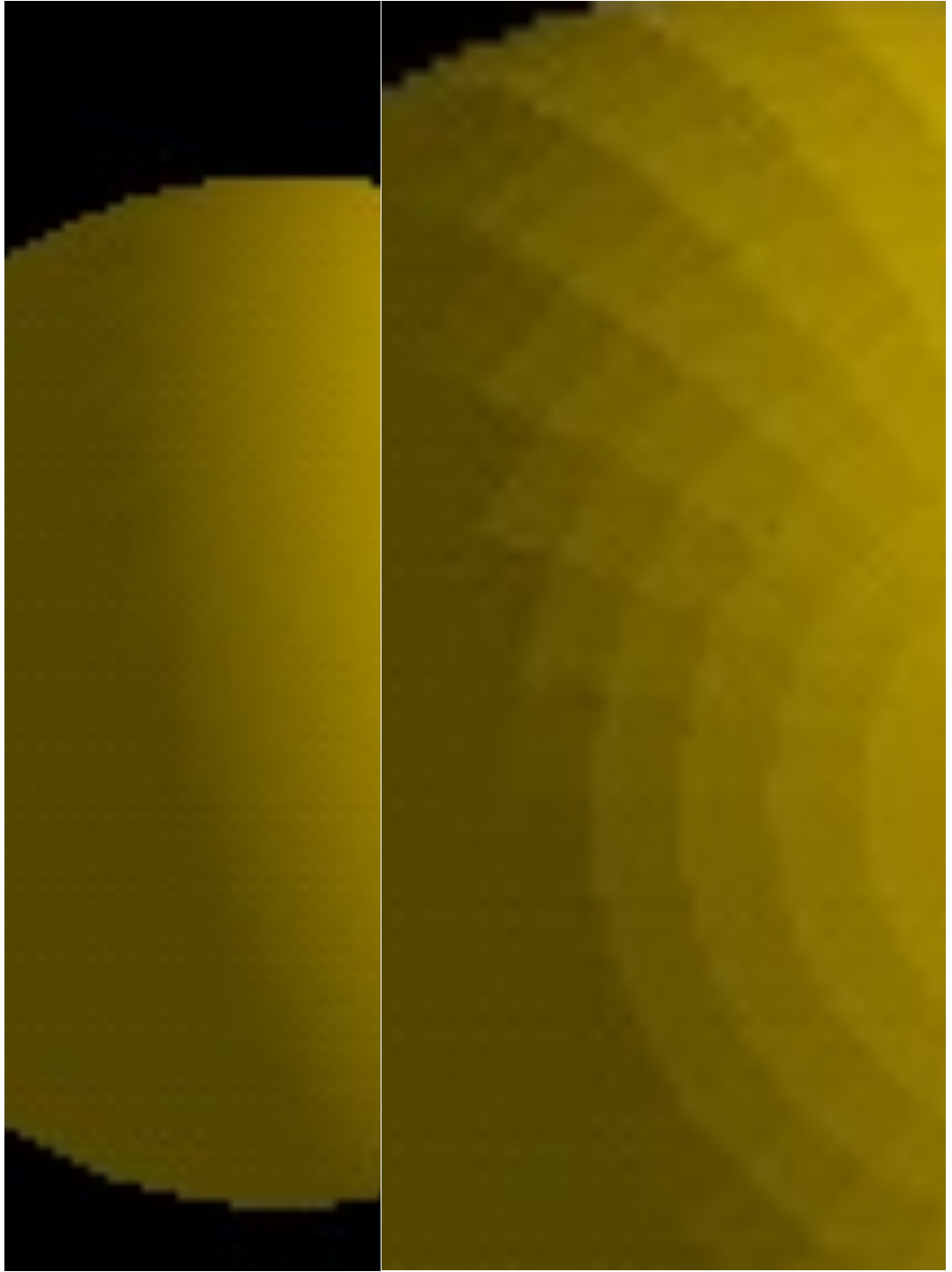
Often appears dull, chalky

- Lacks accurate specular component
  - If included, will be averaged over entire polygon

Flat Shading

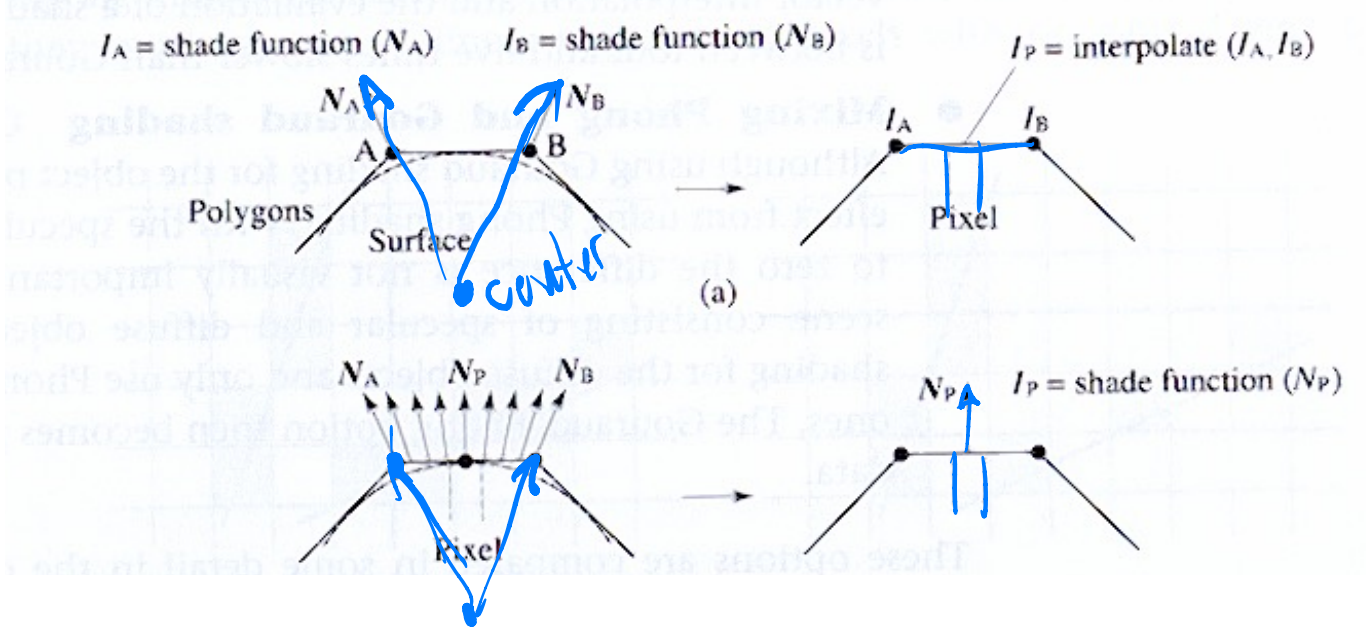
Mach banding

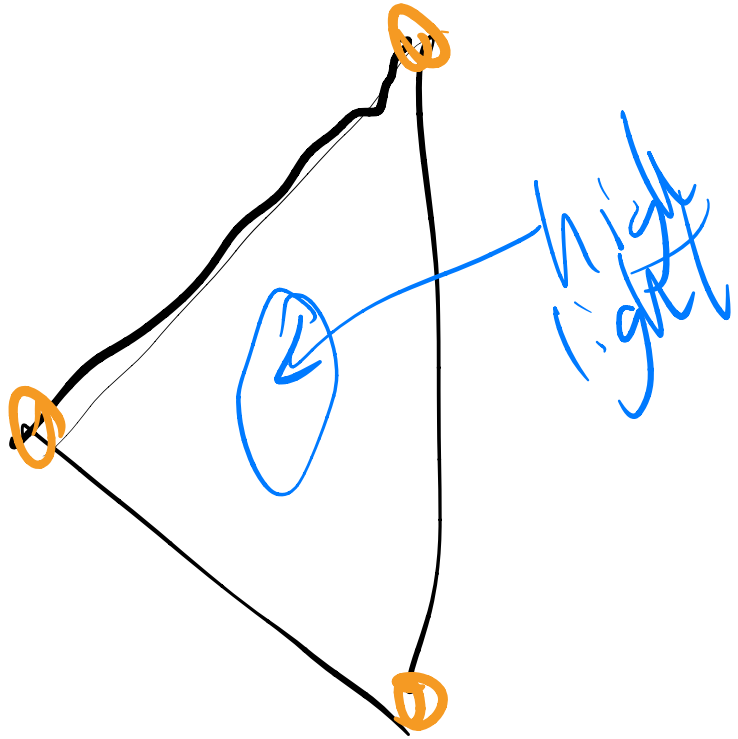
- Artifact at discontinuities in intensity or intensity slope



Shading Models: Per Pixel (Phong Shading)

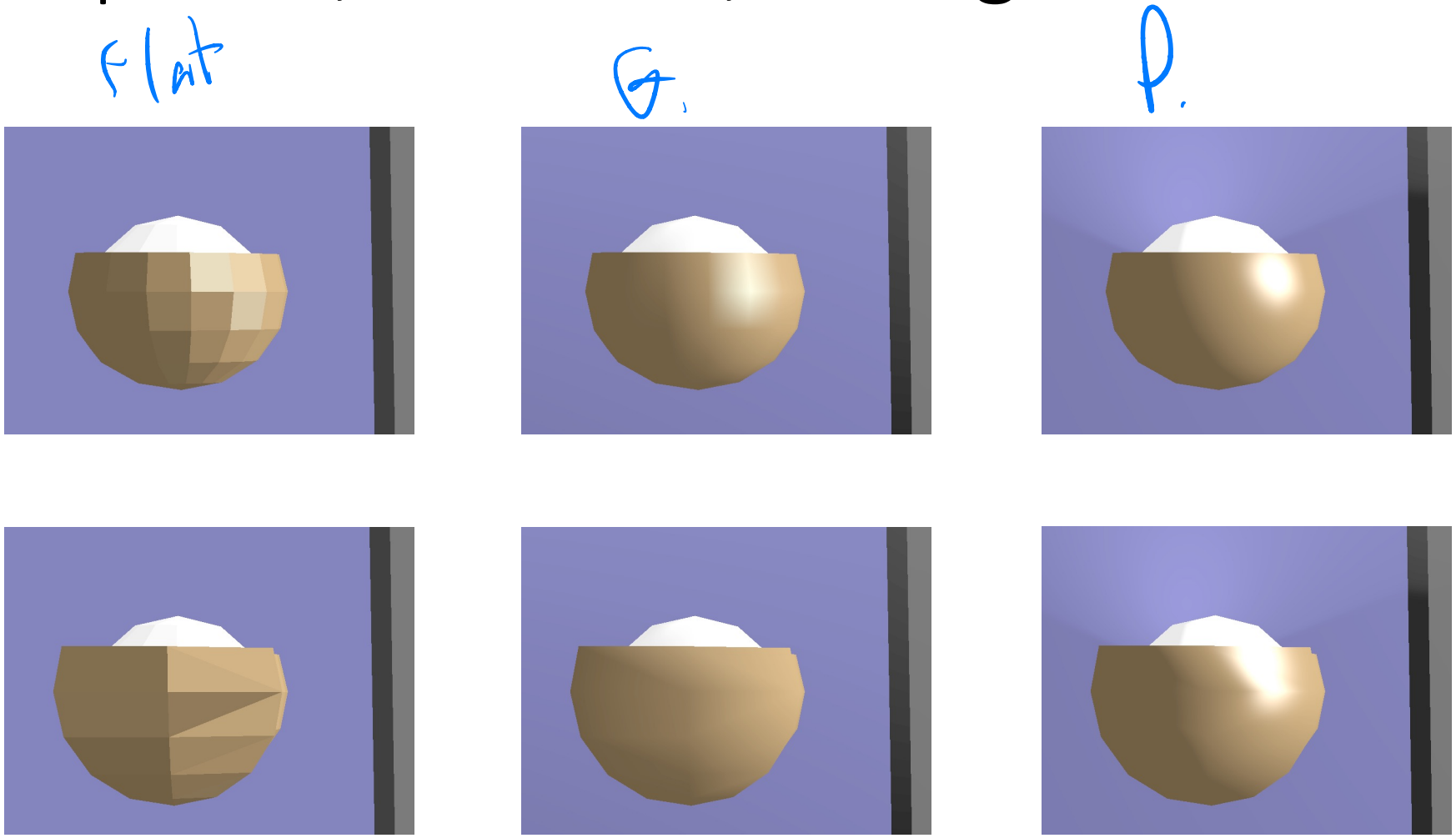
- Linearly interpolate vertex normals
  - Compute lighting eqs. at each pixel
    - Normals must be backmapped to WC





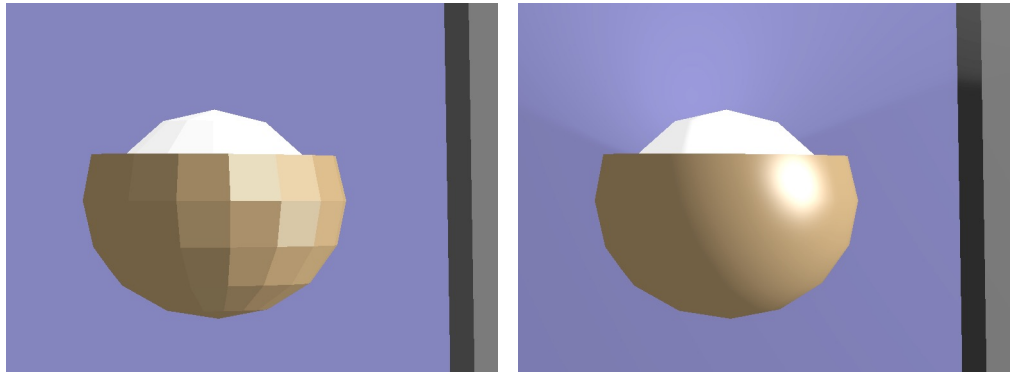
- Can use specular component

Closeup: Flat, Gouraud, Phong

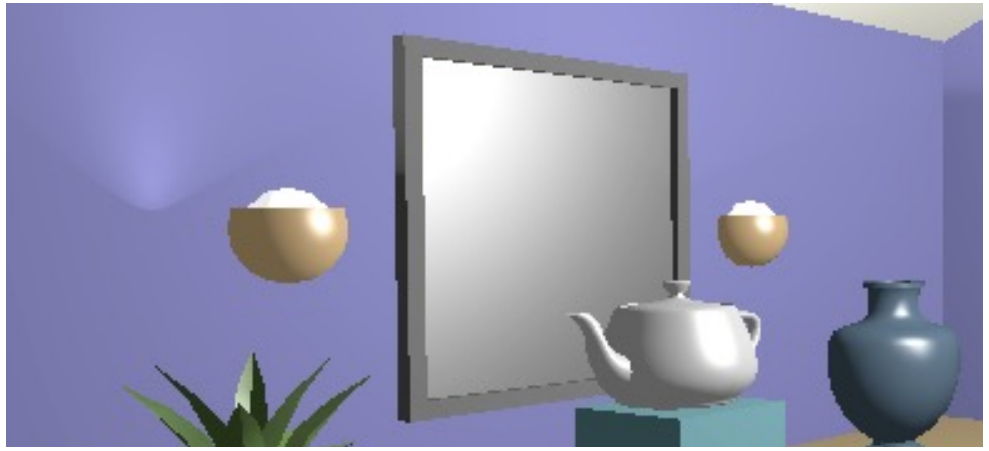


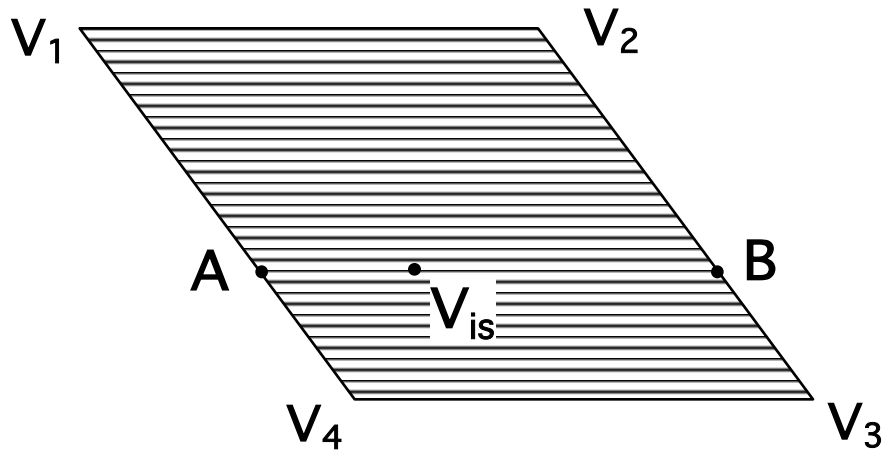
Problems with Interpolated Shading

- Polygonal silhouette



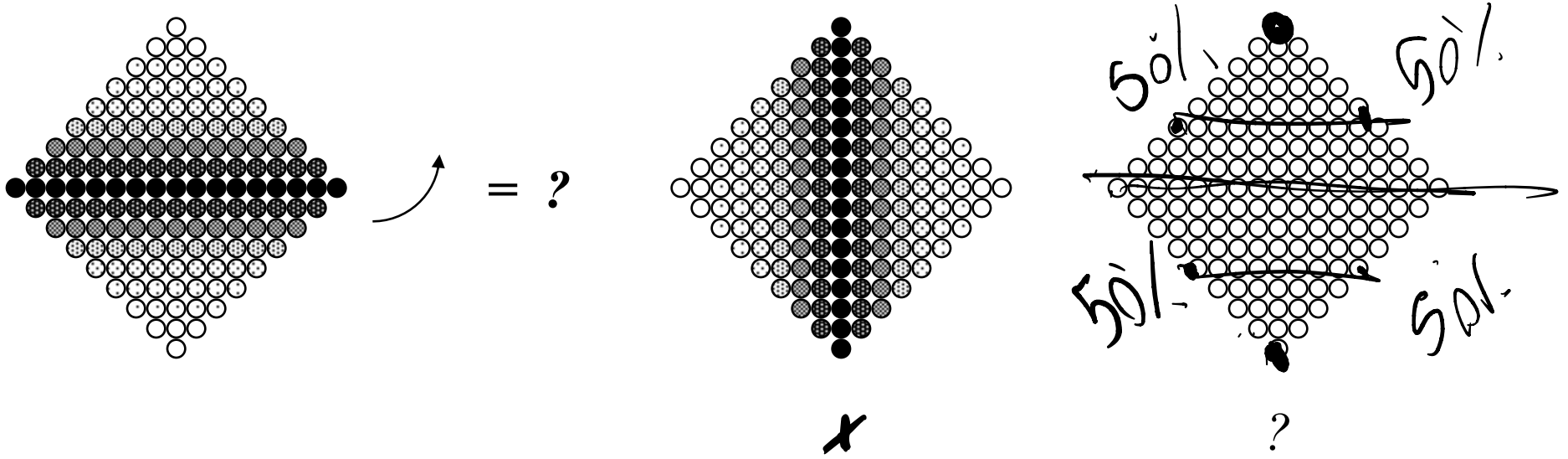
- Perspective distortion





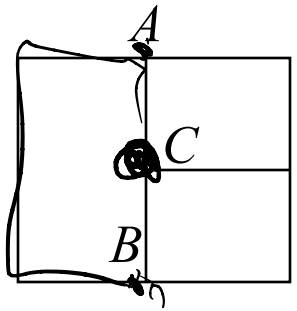
Problems with Interpolated Shading

- Scanline/orientation dependent
  - Creates temporal aliasing when used to render animation frames:

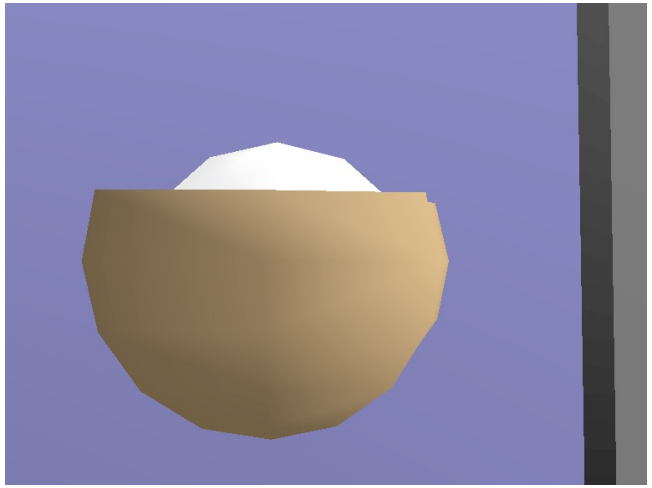


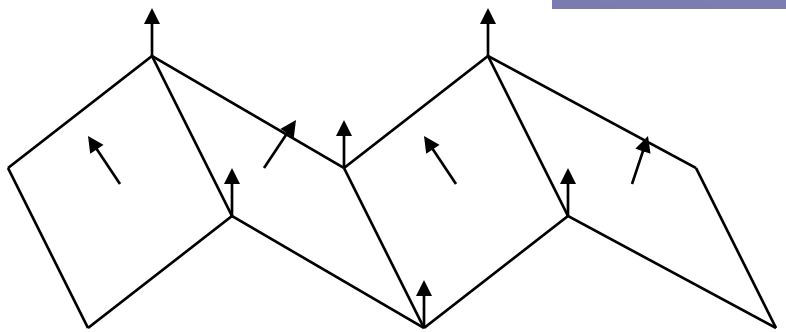
Problems with Interpolated Shading

- Shared vertices



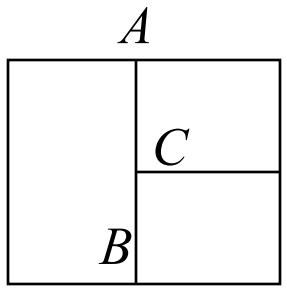
- Unrepresentative vertex normals
  - Missed specular highlights
  - Missed geometry



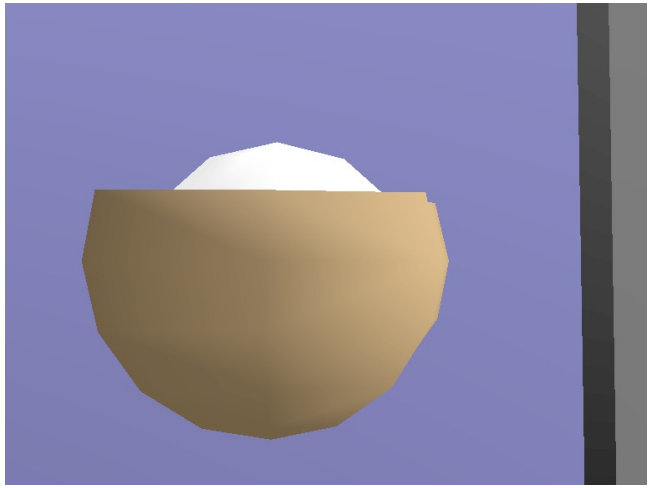


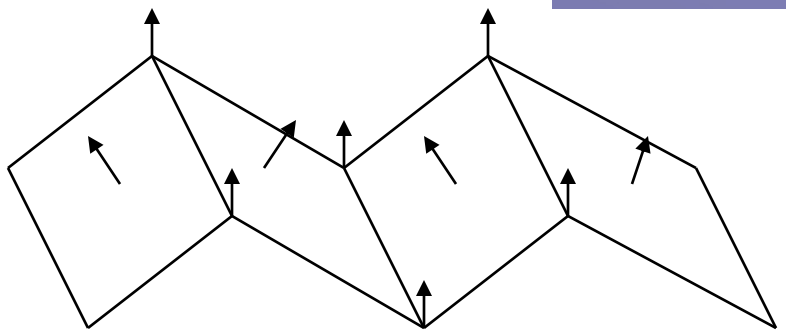
Problems with Interpolated Shading

- Shared vertices



- Unrepresentative vertex normals
  - Missed specular highlights
  - Missed geometry





Basic Material ← roughly our eq's

Standard Material ← more physically based

Lambertian Material ← just diffuse