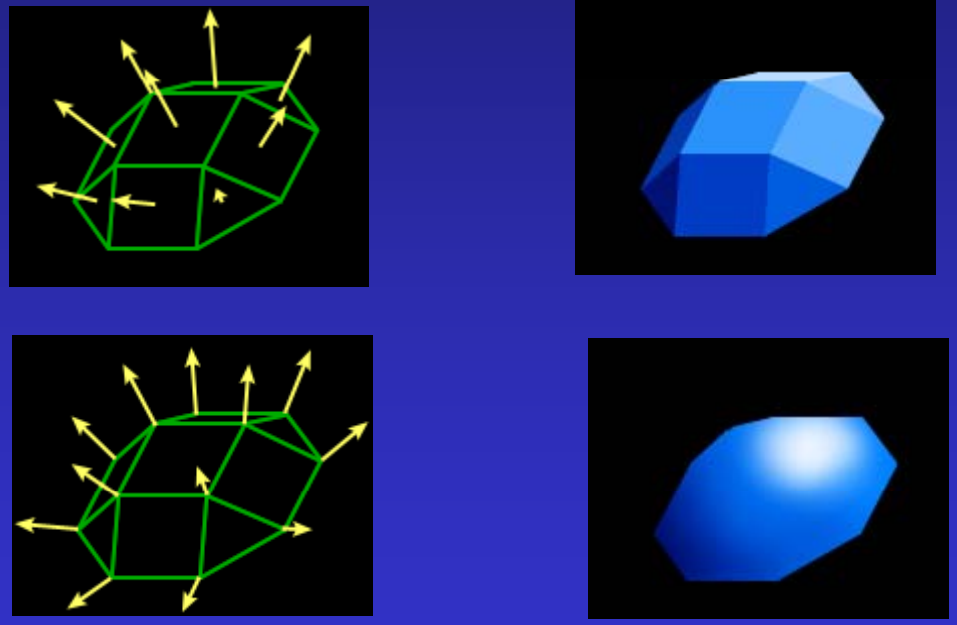
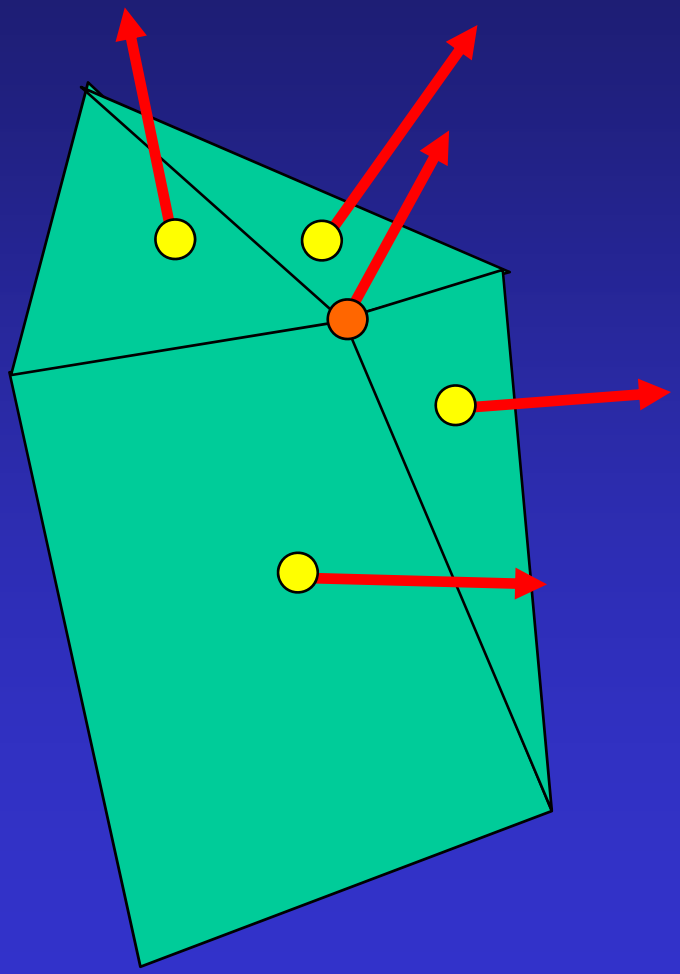
Smooth Shading
Gouraud
Phong

Interpolate value(s) for point in face from values at vertices



http://www.blancmange.info/notes/maths/vectors/primitives/

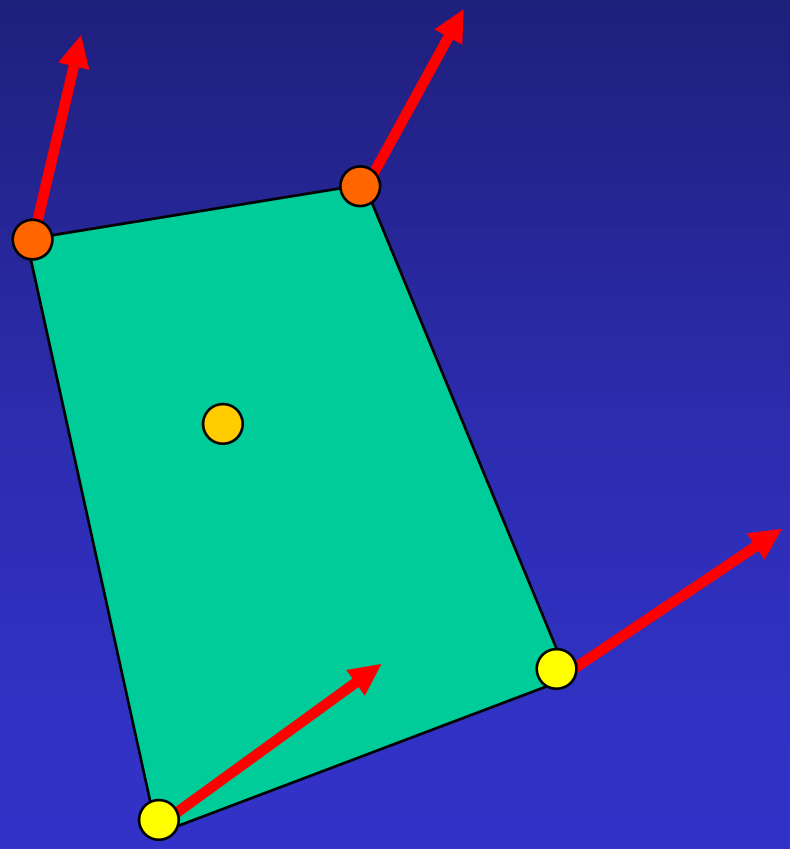
Interpolate normals at vertices



For each vertex, v
  Nv = <0,0,0>
  For each face of vertex
    Compute face normal
    Nv += face normal
  Normalize Nv

For each vertex, v
  Nv = <0,0,0>
For each face
  Compute face normal
  For each vertex of face
    Nv += face normal
For each vertex, v
  Normalize Nv

Interpolate value(s) for point in face from values at vertices



Gouraud smooth shading:

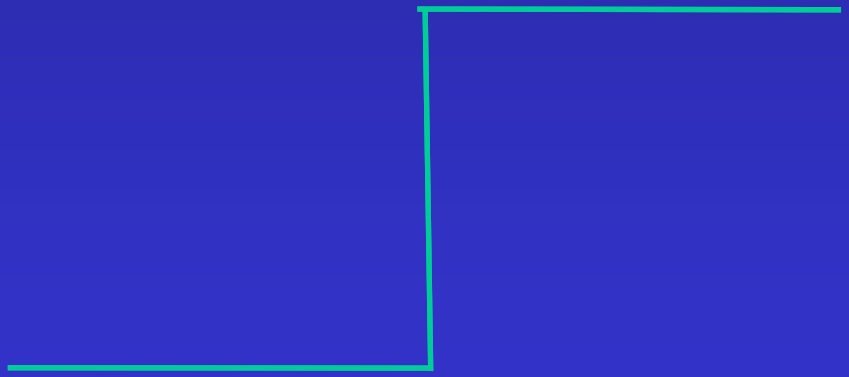
- Compute normals at vertices
- Compute color at vertices
- Interpolate interior color

Mach Band Effect

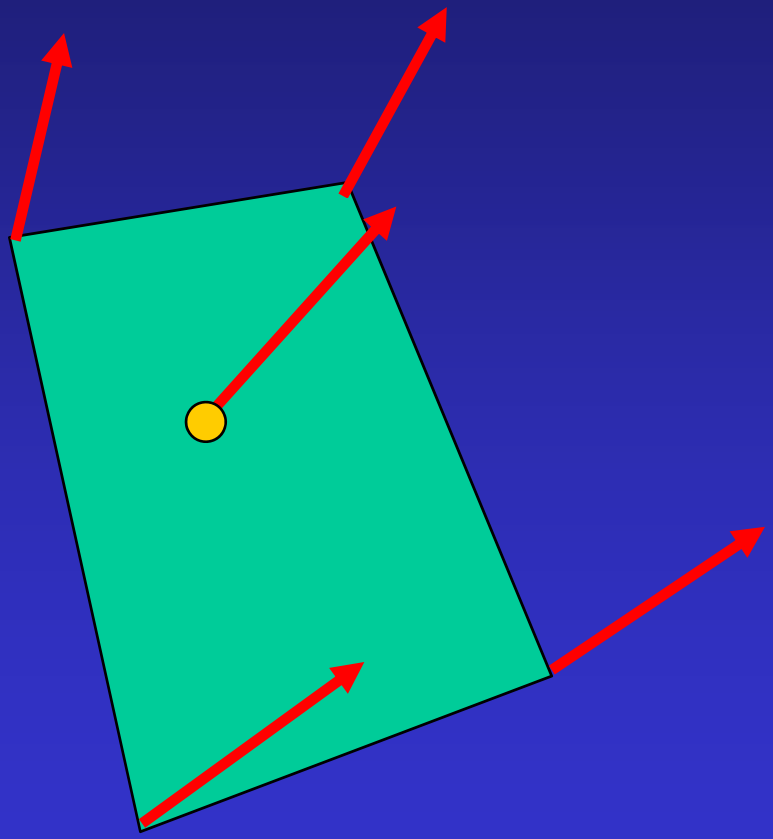
Smoothly shaded objects

Colors are continuous, but not derivatives

Eye picks up on this and accentuates discontinuity



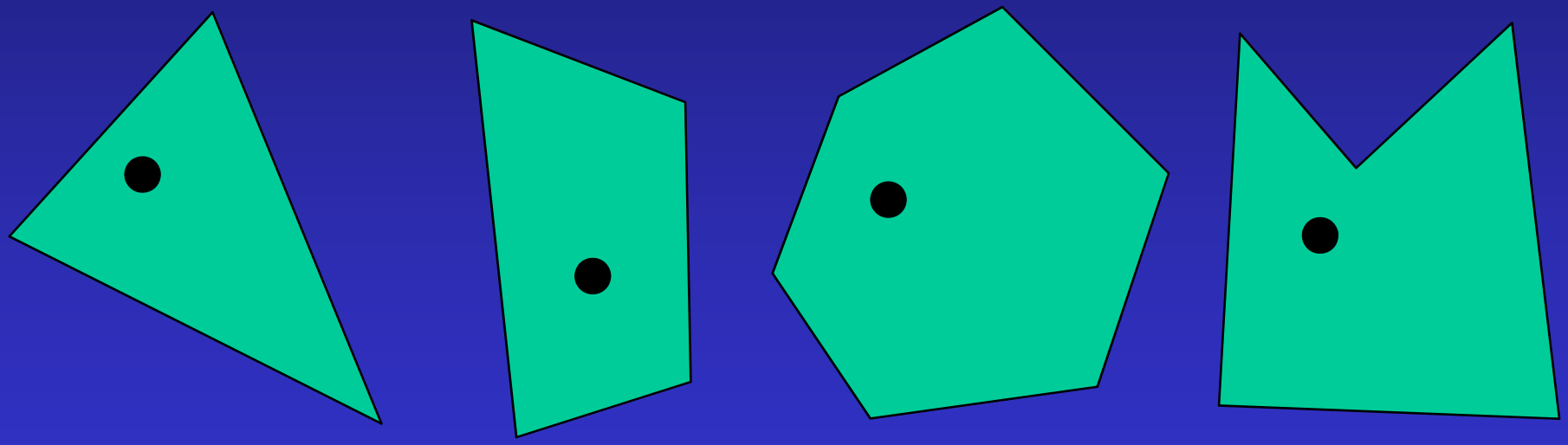
Interpolate value(s) for point in face from values at vertices



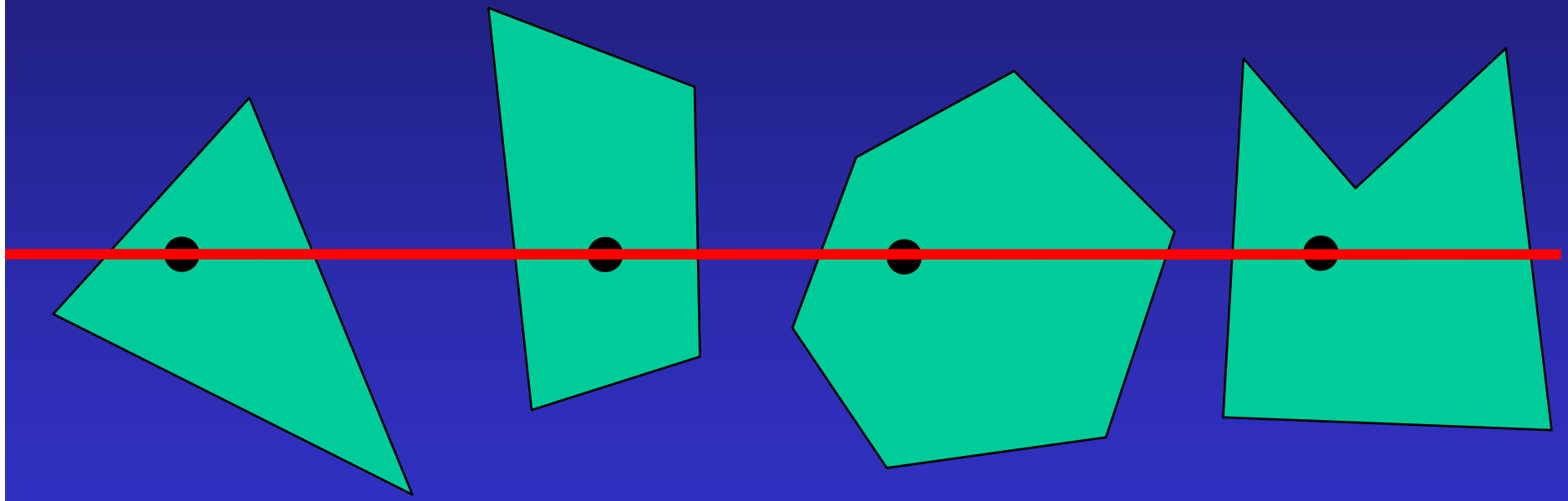
Phong smooth shading:

- Compute normals at vertices
- Interpolate interior normal
- Compute color at point

Interpolate value(s) for point in face from values at vertices

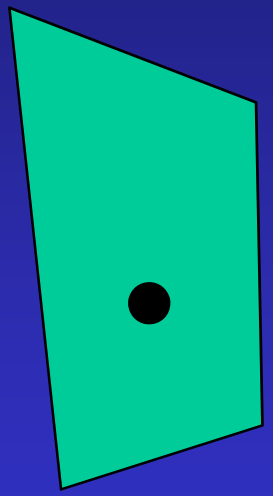


Interpolate value(s) scanline algorithms



Interpolate down edges, across scanline

Point sample Quadrilateral inverse binlinear map then use u,v values to interpolate



$$P_{u0} = (1-u)P_{00} + uP_{10}$$

$$P_{u1} = (1-u)P_{01} + uP_{11}$$

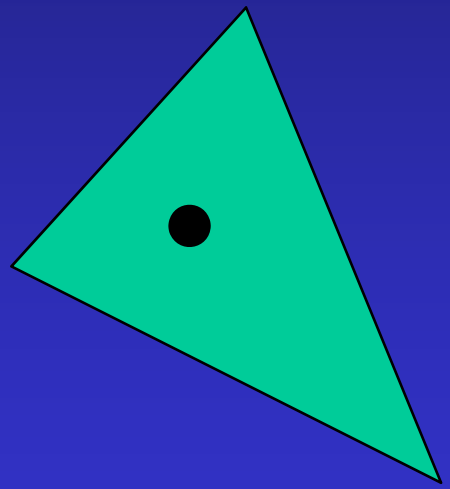
$$P_{uv} = (1-v)P_{u0} + vP_{u1}$$

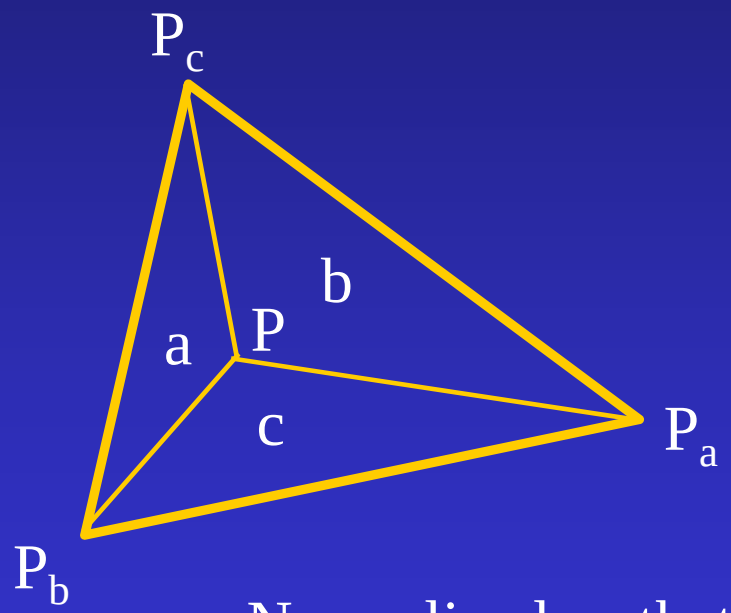
$$P_{uv} = (1-v)((1-u)P_{00} + uP_{10}) + v((1-u)P_{01} + uP_{11})$$

$$P_{uv} = vu(P11 - P_{01} - P_{10} + P_{00}) + v(P_{01} - P_{00}) + u(P_{10} - P_{00}) + P_{00}$$

$$u = \frac{P_{uv} - P_{00} - v(P_{01} - P_{00}) - P_{00}}{v(P_{11} - P_{01} - P_{10} + P_{00}) + (P_{10} - P_{00})}$$

Point sample Triangle compute barycentric coordinates then use to interpolate

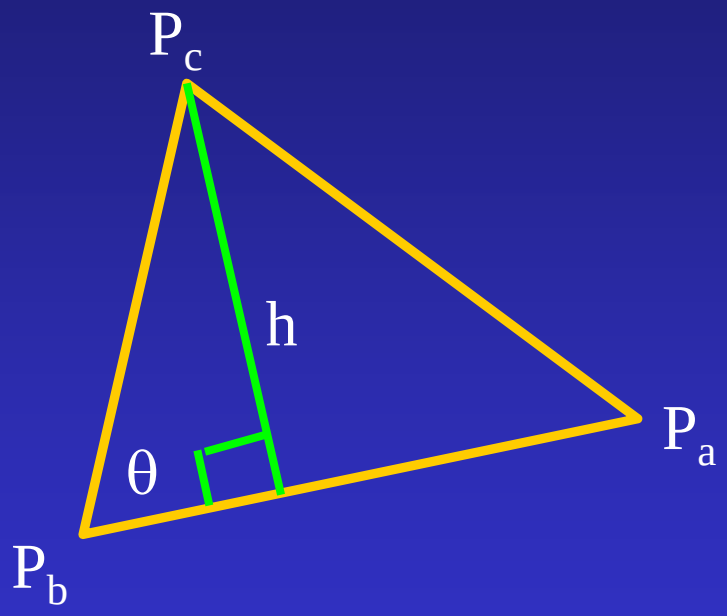




Normalized so that a+b+c=1

$P=aP_a+bPb+cP_c$

Area of a triangle - using vector algebra



$$\text{Area} = (1/2)h|V_{ab}|$$

$$h = |V_{bc}|\sin(\theta)$$

$$\text{Area} = (1/2)\,|V_{ab}|\,|V_{bc}|\sin(\theta)$$

$$|V_{ab} \times V_{bc}| = |V_{ab}|\,|V_{bc}|\sin(\theta)$$

$$\text{Area} = (1/2)\,|V_{ab} \times V_{bc}|$$

Examples of smooth shading

See links off of course web site