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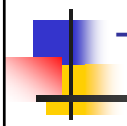

Transforming Normals

Interpolation During Scanconvertion

- interpolate values between vertices
  - z values
  - r,g,b - colour components
  - u,v - texture coordinates
  - N_x, N_y, N_z - surface normals

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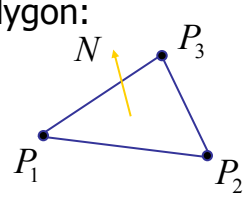
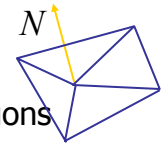
Computing Normals

- polygon:



$$N = (P_2 - P_1) \times (P_3 - P_1)$$

- assume vertices ordered CCW when viewed from visible side of polygon
- normal for a vertex
  - used for lighting
  - supplied by model (i.e., sphere), or computed from neighboring polygons



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Transforming Normals

- What is a normal?
  - **Vector**
    - Orthogonal (perpendicular) to plane/surface
  - Do standard transformations preserve orthogonality?

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Planes and Normals

- Plane - all points where $P \cdot N = 0$
- $PN^T = 0$ (transpose for matrix mult!)

$$P = \begin{bmatrix} x & y & z & 1 \end{bmatrix}$$
$$N = \begin{bmatrix} A & B & C & D \end{bmatrix}$$

- Implicit form

$$Plane = A \cdot x + B \cdot y + C \cdot z + D$$

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Finding Correct Normal Transform

- transform a plane

$$\begin{matrix} P \\ N \end{matrix} \longrightarrow \begin{matrix} P' = PM \\ N' = NQ \end{matrix}$$

Given M, find Q

$P' N'^T = 0$ **stay perpendicular**

$(PM)(NQ)^T = 0$ **substitute from above**

$PMQ^T N^T = 0$ $\quad (\mathbf{AB})^{\mathbf{T}} = \mathbf{B}^{\mathbf{T}}\mathbf{A}^{\mathbf{T}}$

$MQ^T = I$ $\quad PN^T = 0$

$$Q = \left(M^{-1}\right)^T$$

Normal transformed by *inverse transpose* of modelling transformation

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