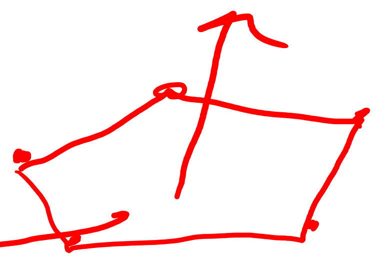
CMSC427
Parametric surfaces: computing normals

Computing normal vectors for mesh

- Approach 1: Cross product of numeric data
  - Find v1 and v2 from vertices (which?)
  - N = v1 x v2

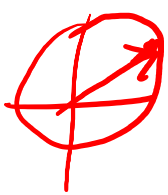
- Approach 2: Partial derivatives of parametric curve
  - Given vector P(u,v) = < x(u,v), y(u,v), z(u,v)>
  - Derive vectors dU = dP(u,v)/du and dV = dP(u,v)/dv
  - N = dU x dV

- Other approaches:
  - Newell's method
  - Gradient vector of implicit surface
    - Given implicit function f(x,y,z)
    - Derive gradient < df/dx, df/dy, df/dz >



not perfect plane

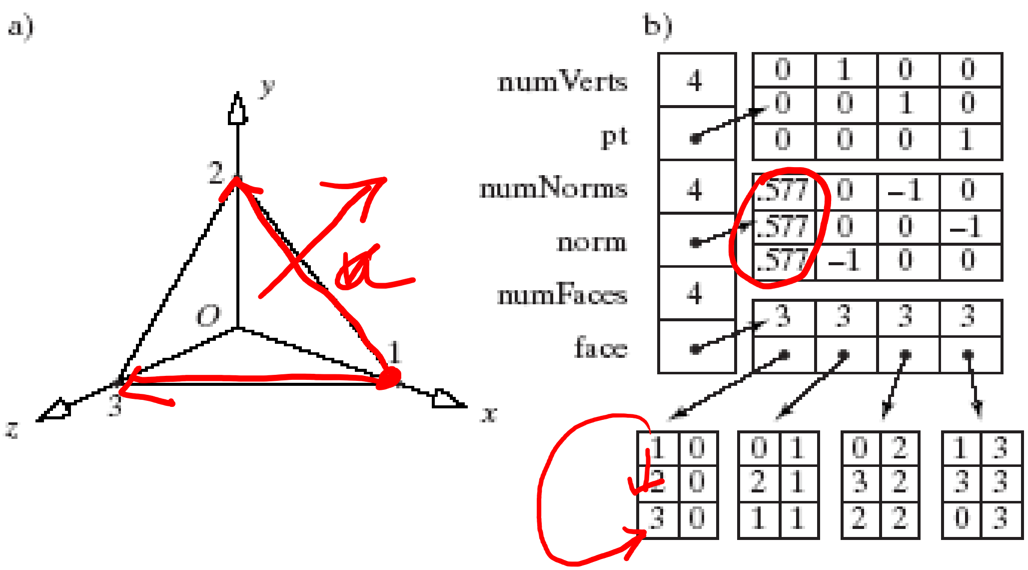
$x^2+y^2+z^2-R^2=0$



$\langle x,y,z \rangle$

$\Leftarrow \langle 2x, 2y, 2z \rangle$

Example: Tetrahedron



vectors
vertices - p

✓

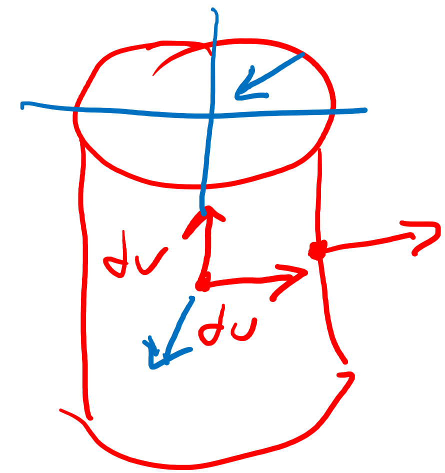
$a = p_2 - p_1 \qquad a \times b$

$b = p_3 - p_1$

Example: Cylinder

- Parametric cylinder (full derivation on Elms handout)

$$p(u,v) =< R\ cos\ u\ , h*v, R\ sin\ u >$$



$$\frac{dp(u,v)}{du} = \langle -R\sin u,\ 0,\ R\cos u \rangle$$

$$\frac{dp(u,v)}{dv} = \langle 0,\ h,\ 0 \rangle$$

$$n = \frac{dp(u,v)}{du} \times \frac{dp(u,v)}{dv} = \langle -R\sin u,\ 0,\ R\cos u \rangle \times \langle 0,\ h,\ 0 \rangle$$

$$= \langle -\underline{hR}\cos u,\ 0,\ -\underline{hR}\sin(u) \rangle$$

$$\bar{n} = \frac{-n}{|n|} = \langle \cos u,\ 0,\ \sin(u) \rangle$$