Announcements

"Coffee hour" tomorrow @ 10:30

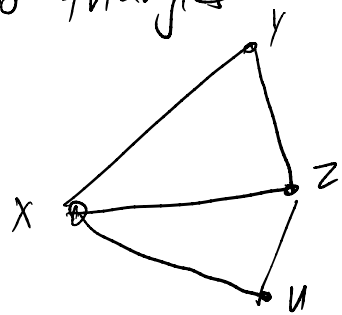
Project 4 due tomorrow (or Sunday)

Grade distribution

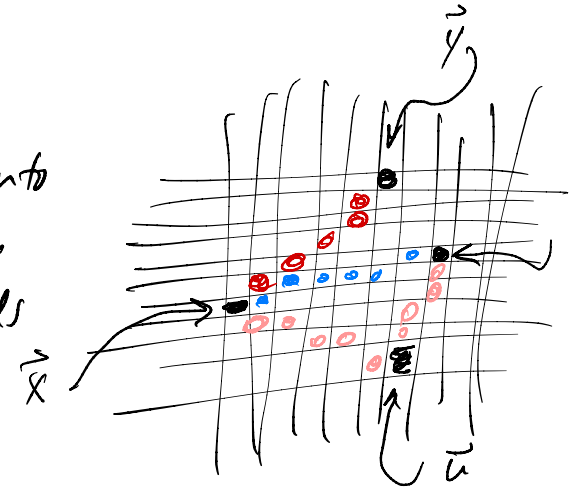
	#
100 - 120	23
80 - 100	18
60 - 80	17
40 - 60	17
< 40	2

"Stiching" surfaces:

Two triangles



render onto an array of pixels



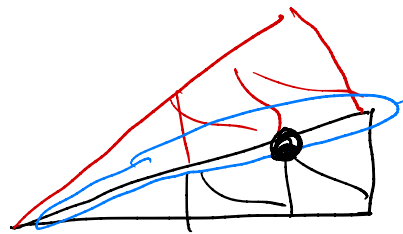
Pixels on boundary between Δxyz and Δxuz (blue)

each pixel should belong to exactly one of the triangles.

Worst problem: Some pixel is missed.

A pixel belonging to both, will mess up transparency.

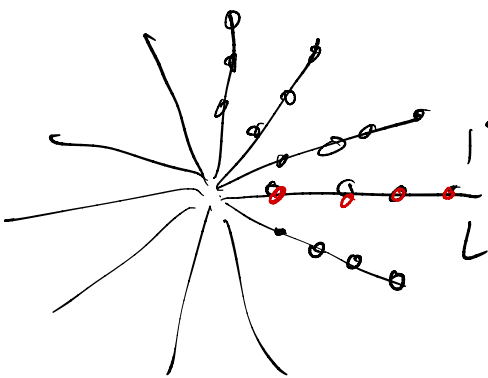
Render a surface of revolution - by using a triangle strip that is rotated + rendered multiple — Will cause problems from roundoff errors



Same strip rotated.

Triangle strip

Round off errors can make common verts can not quite coincide.

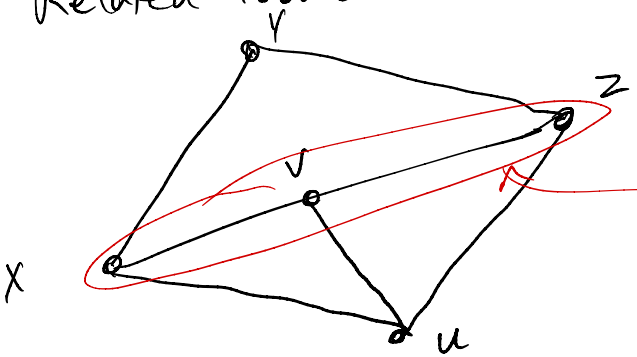


If compute vertices with $\theta = 0$ and $\theta = 2\pi$ to finish.

With limited precision

$\sin(0) \neq \sin(2\pi)$

Related issue

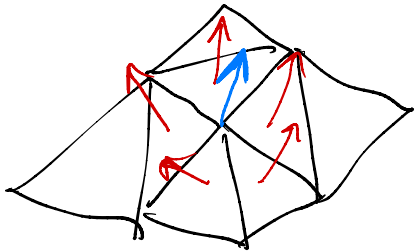


Risk of pixels not correctly being in exactly one triangle.

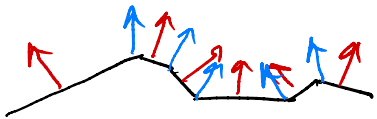
<u>Fix</u>: Split Δxyz into 2 triangles namely Δxyv and Δvzy

Overview of computing surface normals: Three methods

Goal Render a set of triangles to generate a smooth looking surface



Add normals to help us render lighting



Method #1 Approximation to a surface

Use normals for the triangles

Average normal of adjacent triangles to estimate the normal on a vertex

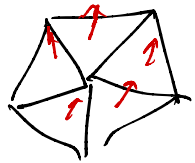
$$n = \sum_i n_i$$

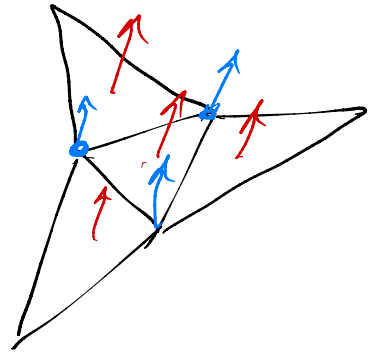
Assume n_i's are unit vectors

Possibly normalize $\vec{n}$.

↑ ie. make it to unit vector.

Question

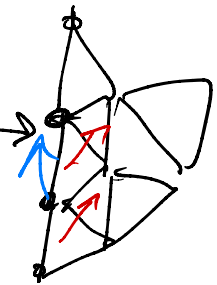




Research topic?

Question

Boundary



<u>See ideas</u> For mathematically defined surface

(1) Gradient method Level set $\{\langle x,y,z\rangle : H(x,y,z)=0\}$

∇H - gradient

(2) Cross products of partial derivatives method

$\vec{p} = \vec{p}(u,v)$

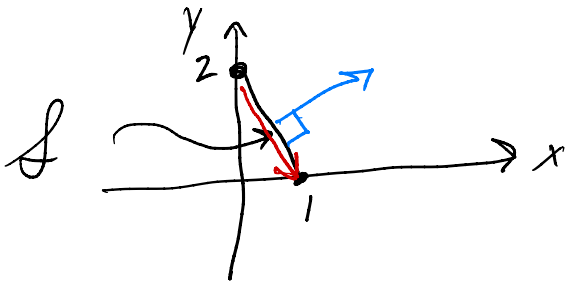
Surface of revolution

$\vec{p}(r,\theta) = \langle r\sin\theta, h(r), r\cos\theta\rangle$

$$\frac{\partial \vec{p}}{\partial u} \times \frac{\partial \vec{p}}{\partial v}.$$

Transforming Normals:

Example in $\mathbb{R}^2$



$\langle 1,-2\rangle$ is tangent to the surface

$\langle 1,-2\rangle \cdot \langle 2,1\rangle = 0$

Slope -2

Normal vector: $\langle 2,1\rangle$ (for example)

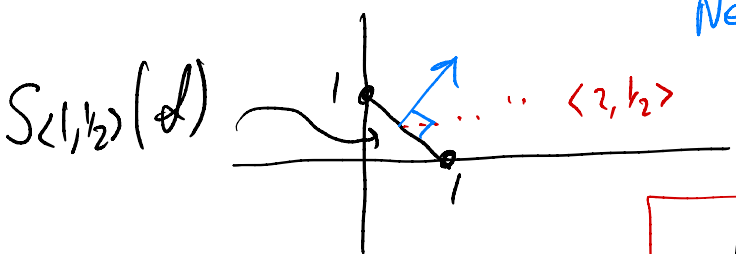
Did not form

$S_{\langle 1,\frac{1}{2}\rangle}(\langle 2,1\rangle) = \langle 2,\frac{1}{2}\rangle$

Transform by $S_{\langle 1,\frac{1}{2}\rangle}$ (scaling)

Slope -1

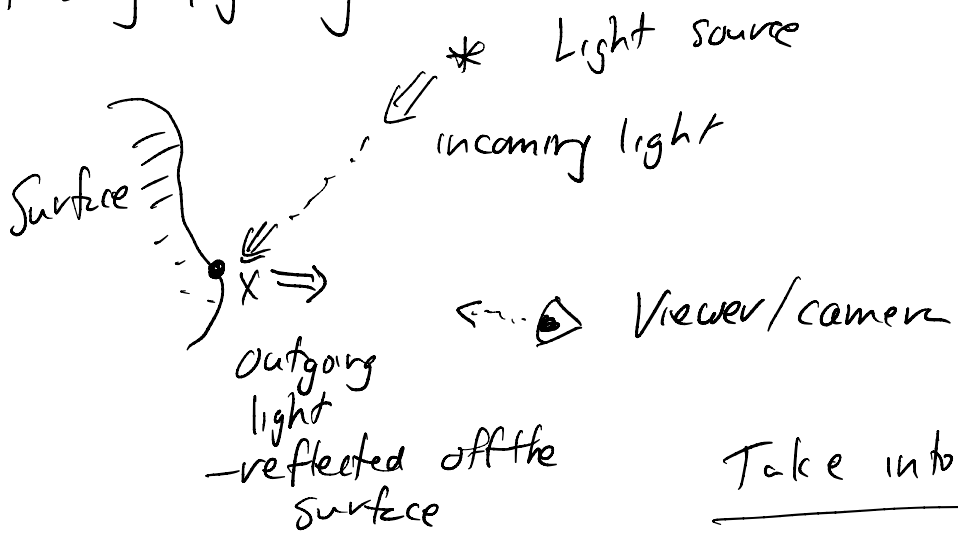
New normal vector: $\langle 1,1\rangle$



Let M be the 3×3 matrix for the transformation.

$$\boxed{\text{Normal transforms by } \quad n \mapsto (M^T)^{-1} n}$$

Phong lighting



Types of lighting

- Ambient light (directionless)
- Diffuse light (incoming direction, reflect in all directions
- Specular - "almost" mirror-like reflection.

Take into account:

- Direction of the incoming light $\vec{l}$
- Surface normal $\vec{n}$
- Direction to viewer $\vec{v}$
- Color/brightness of the light
- Reflectivity of the surface.