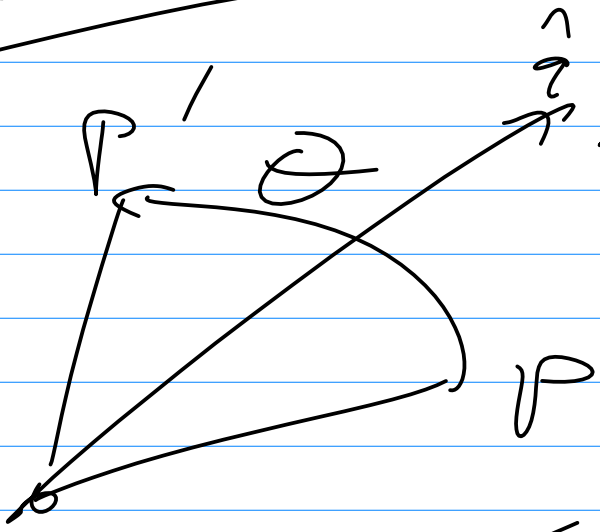
12/12/11

3D ROTATION



- INTUITIVE 45° ABOUT $\frac{(3,4,5)}{\sqrt{\quad}}$
- ANIMATE IN MANY SMALL STEPS

1000 STEPS OF $\frac{45°}{1000}$

ABOUT $\frac{(3,4,5)}{\sqrt{\quad}}$

2 MATRIX FORM — COMBINE

3 EULER ANGLES
CONCEPTUALIZE
MATCH HW IN GYROSCOPES ETC.

4 QUATERNIONS { AXIS + ANGLE
CAN COMBINE

~~THERE MIGHT BE LITTLE~~
COMPUTATION QUESTIONS
LIKE WHAT ARE AXIS + ANGLE FOR
THIS QUATERNION.

$$q = .7 + .7j$$

$$q = \cos\frac{\theta}{2} + \sin\frac{\theta}{2}\left(a_x i + a_1 j + a_2 k\right)$$

AXIS

$= .7$

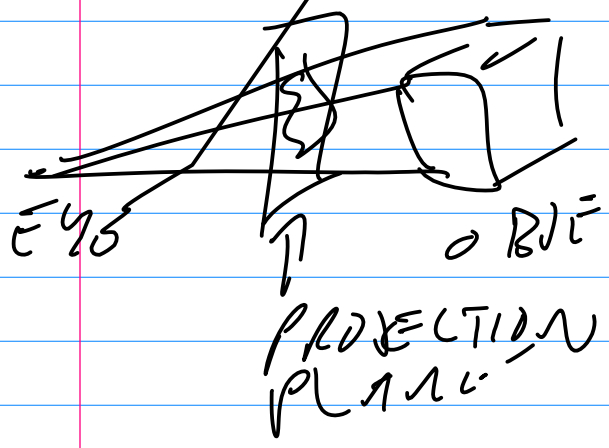
$\theta = \pm 45°$

$.7j = \sin\frac{\theta}{2}\,AXIS$

$AXIS = (0, 1, 0)$
$OR\ (0, -1, 0)$

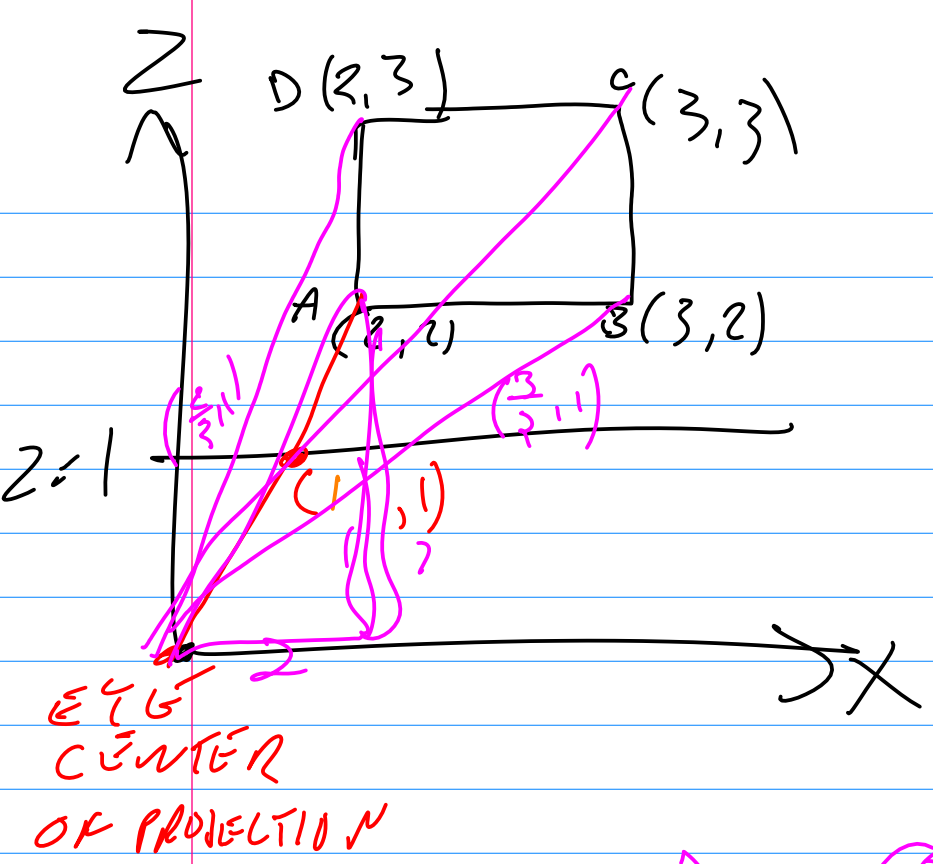
VIEW NORMALIZATION 3

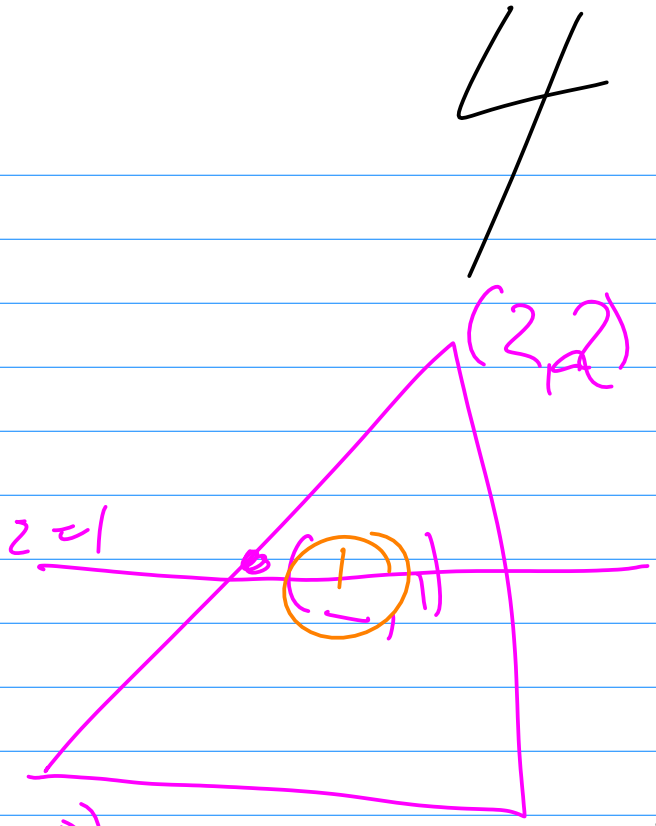
PERSPECTIVE PROJECTION



TO DISTORT THE OBJECT SO THAT THE DISTORTED OBJECT CAN BE PARALLEL PROJECTED

THE RESULTING IMAGE IS SAME





$(x, 2) \to \left(\frac{x}{2}, 1\right)$

PERSPECTIVE PROJECTION

$A(2,2) \to A'(1,1)$

$B(3,2) \to B'\left(\frac{3}{2}, 1\right)$

$C(3,3) \to C'(1,1)$

$D(2,3) \to D'\left(\frac{2}{3}, 1\right)$

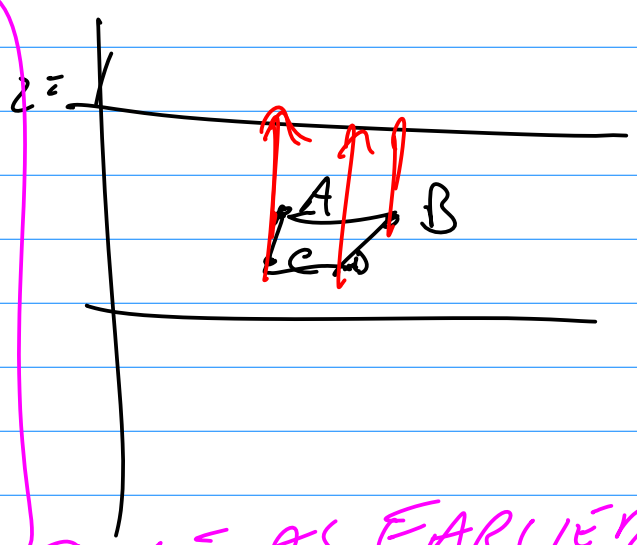
DISTORTED SQUARE

$A\left(1, \frac{1}{2}\right) \to (1, 1)$

$B\left(\frac{3}{2}, \frac{1}{2}\right) \to \left(\frac{3}{2}, 1\right)$

$C\left(1, \frac{1}{3}\right) \to (1, 1)$

$D\left(\frac{2}{3}, \frac{1}{3}\right) \to \left(\frac{2}{3}, 1\right)$



SAME AS EARLIER CASE

NOW DO PARALLEL PROJECTION

$(x, z) \to (x, 1)$

HOMOGENEOUS COORDS

3D $(x_H, y_H, z_H, w) \rightarrow \left(\frac{x_H}{w}, \frac{y_H}{w}, \frac{z_H}{w}\right)$

$(1,2,3,4) \rightarrow \left(\frac{1}{4}, \frac{2}{4}, \frac{3}{4}\right)$

HOMOGEN CARTES

$w = 0 \Rightarrow$ POINT AT INFINITY

- TRANSLATION CAN BE A MATRIX MULTIPLY

TRANSLATE BY $(3, 4, 5)$

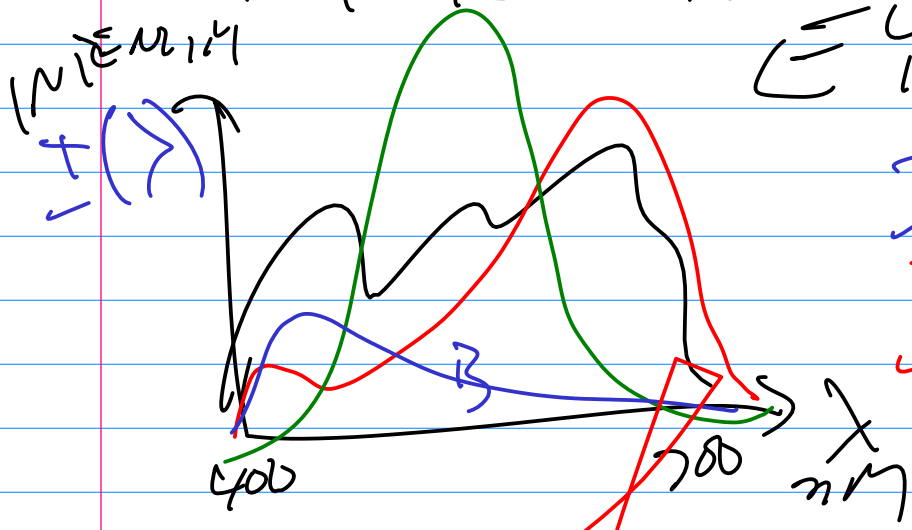
$$\begin{pmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \\ 3 \\ 1 \end{pmatrix} = \begin{pmatrix} 4 \\ 6 \\ 8 \\ 1 \end{pmatrix}$$

$(1,2,3)$ TRANSLATED BY $(3,4,5)$ IS $(4,6,8)$

COLORS

TRISTIMULUS

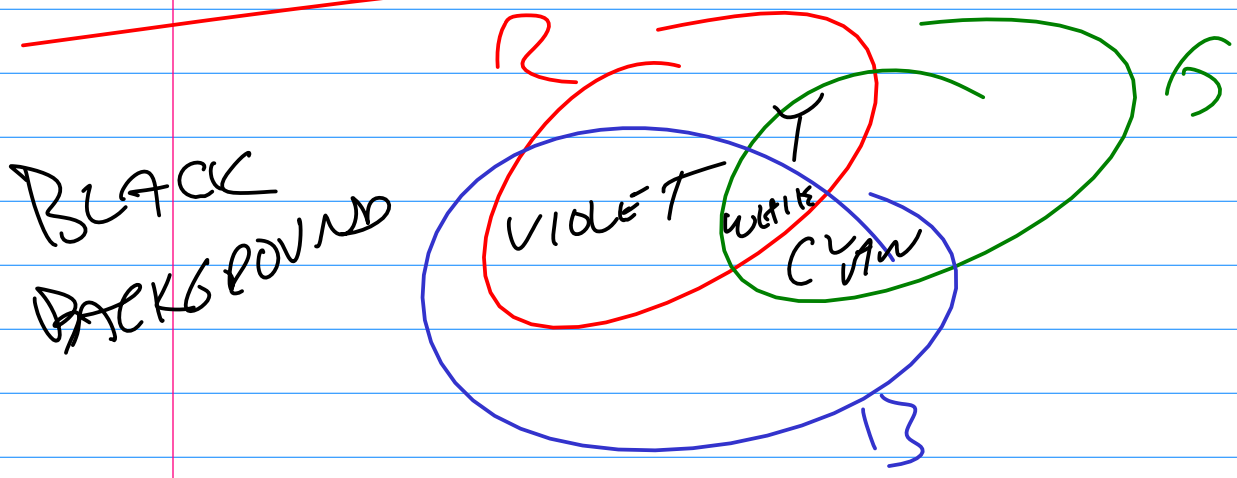
R, G, B RECEPTORS IN EYE



$$I_B = \int I(\lambda) B(\lambda) d\lambda$$

$$I_R = \int I(\lambda) R(\lambda) d\lambda$$

ADDITIVE MODEL — SPOTLIGHT

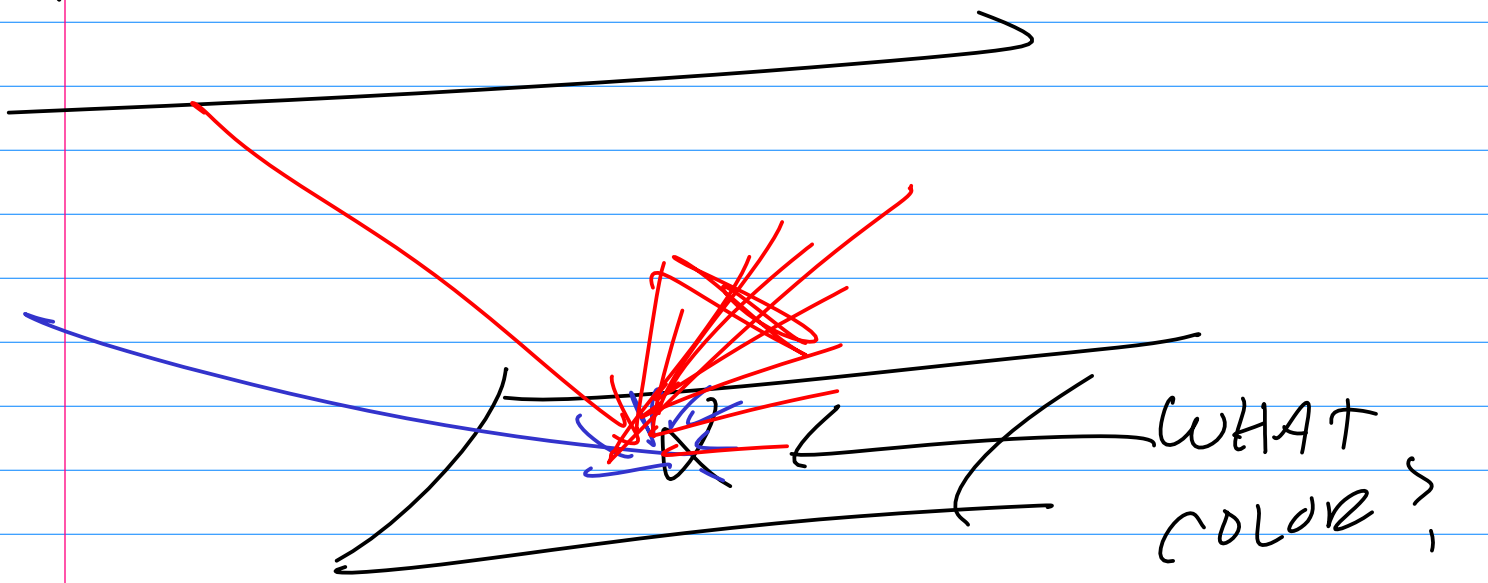


BLACK BACKGROUND

SUBTRACTIVE — INK ON PAPER.

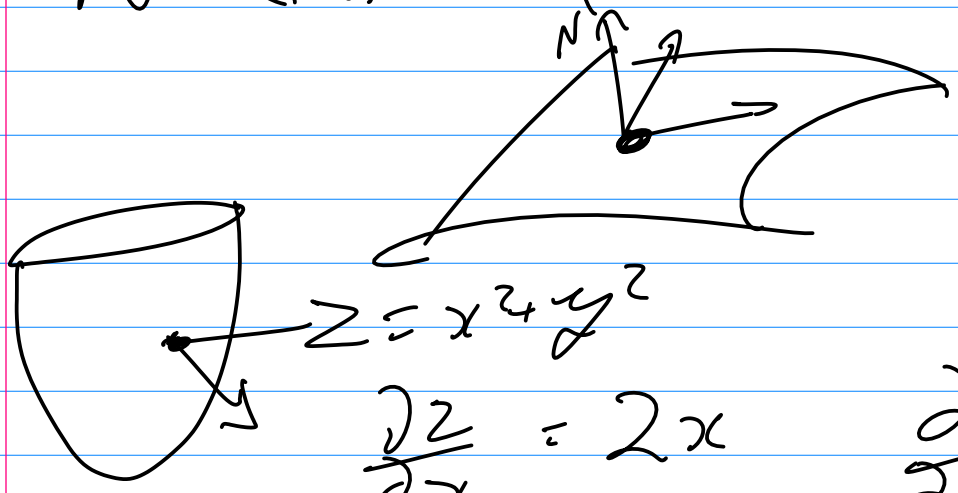
WHITE BACKGROUND —

PHONG LIGHTING



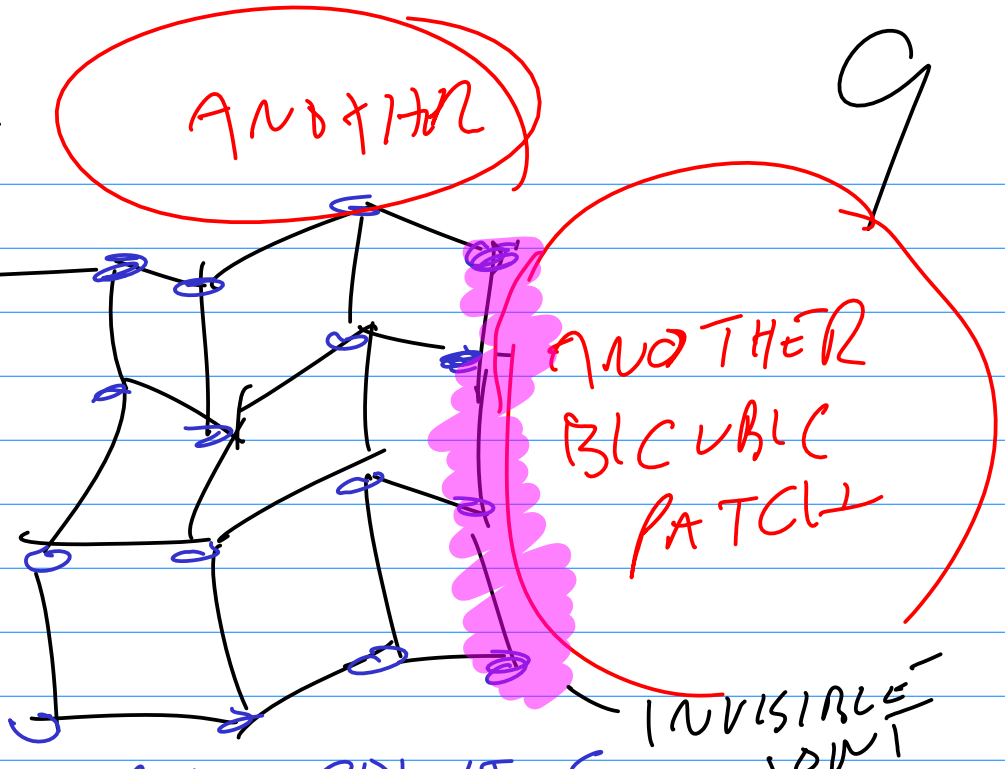
AMBIENT + DIFFUSE + SPECULAR
+ EMITTED

NORMAL TO SURFACE



FOR IMPLICIT SURFACE, $x^2+y^2+z^2-1=0$
GRADIENT IS NORMAL.

MESHING



4X4 CONTROL POINTS

- FIND A SMOOTH SURFACE FROM CONTROL GRID:
  e.g. BEZIER SURFACE

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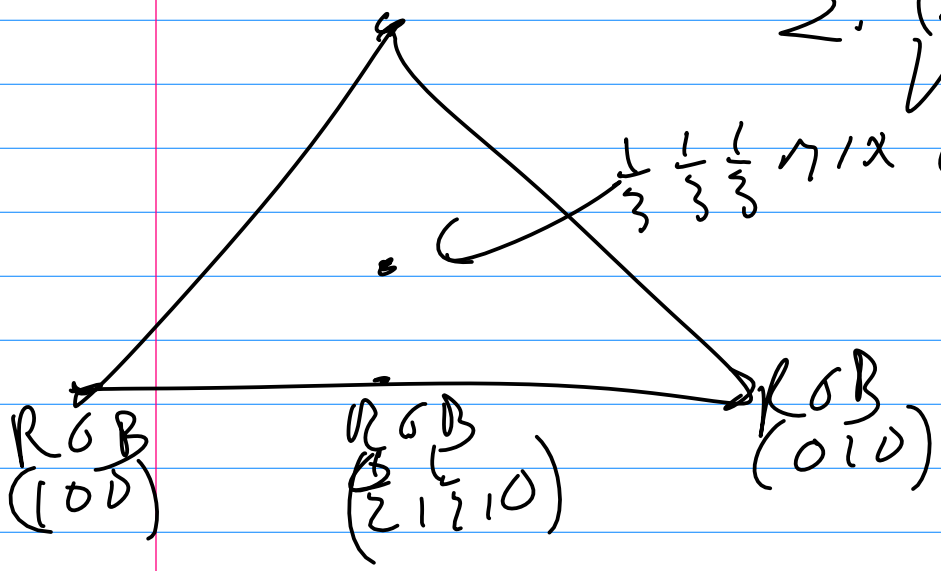
4 QUALITY LEVELS FOR SHADING

1. 1 COLOR
2. INTERPOLATE VERTEX COLORS



3rd QUALITY LEVEL

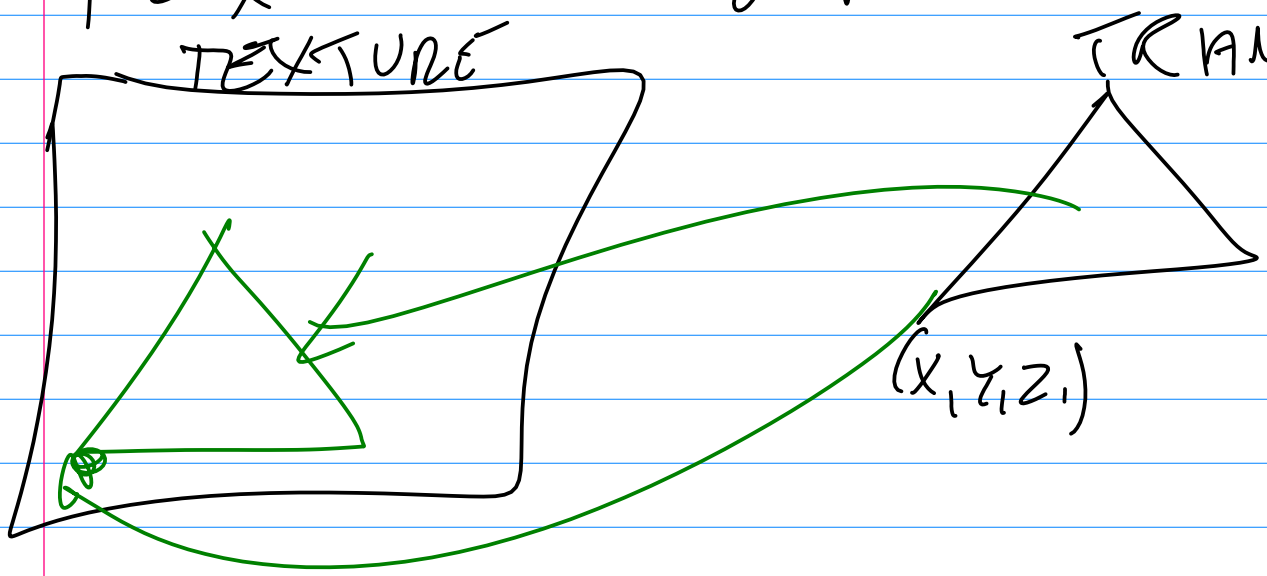
USER SPECIFIES SURFACE NORMALS @ VERTICES

OPENGL PHONG COLORS VERTICES + INTERPOLATES COLOR

4. INTERPOLATE NORMALS + COMPUTE COLOR PER PIXEL

- ONLY #4 CAN PRODUCE A HIGHLIGHT INSIDE TRIANGLE.

TEXTURÉ MAP



PIPELINES AKA SHADERS

VERTEX SHADER → RASTERIZER → FRAGMENT SHADER

- VERTEX SHADER: aj NORMAL PER VÉR.
- FRAGMENT SHADER: NORMAL PER PIXEL → COLOR PER PIXEL