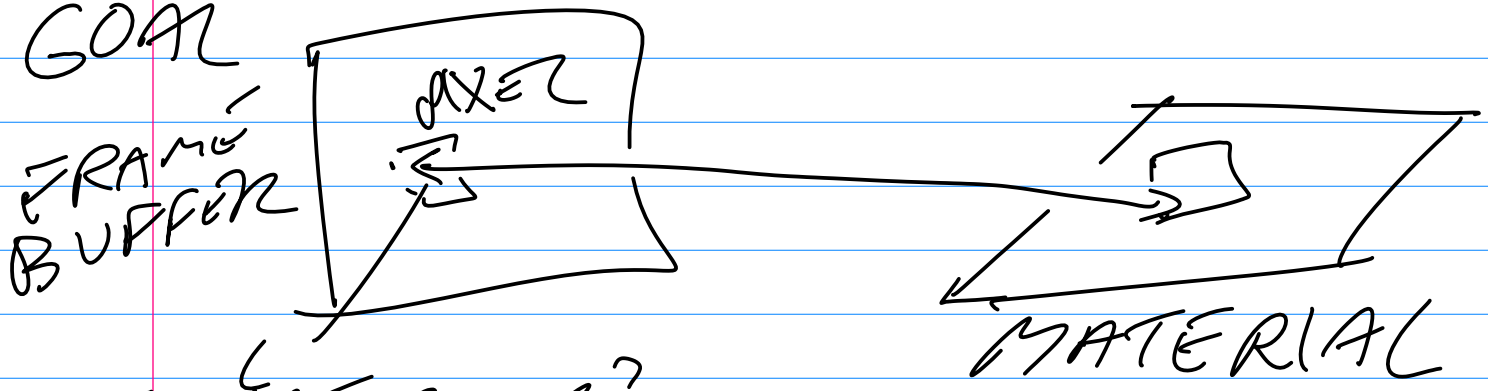
10/31/11

LIGHTING

CH 11

PHONG LIGHTING MODEL

GOAL



WHAT COLOR?

MAT PROPERTIES

LIGHT PROP

(1) AMBIENT COLOR

AMB BRIGHT.

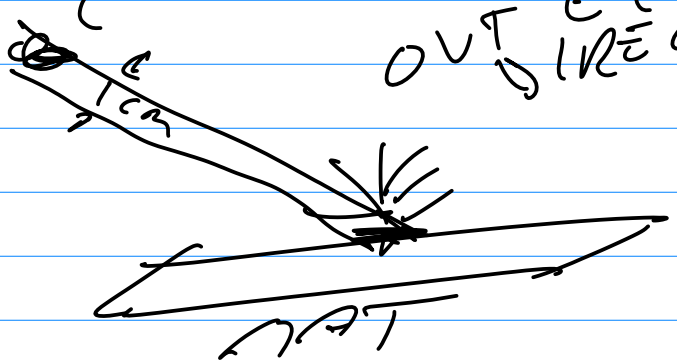
$(V_{AMB,R}, V_{AMB,G}, V_{AMB,B})$ $(L_{AMB,R}, L_{AMB,G}, L_{AMB,B})$

RED COMP OF AMB BRIGHT

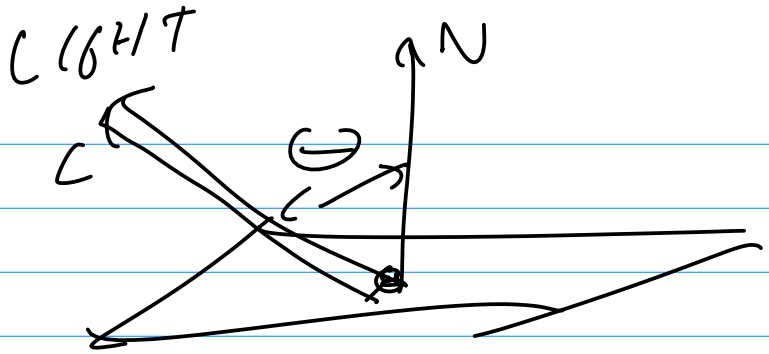
$= V_{AMB,R} \cdot L_{AMB,R}$ ETC.

(2) DIFFUSE

EQUALLY IN ALL OUT DIRECTIONS



LOW ON HORIZON ⇒ DIMMER



UNIT WIDTH OF LIGHT SPREADS OVER AREA OF $\frac{1}{\cos\theta}$

∴ PIXEL DIMS BY A FRACTION $\cos\theta$

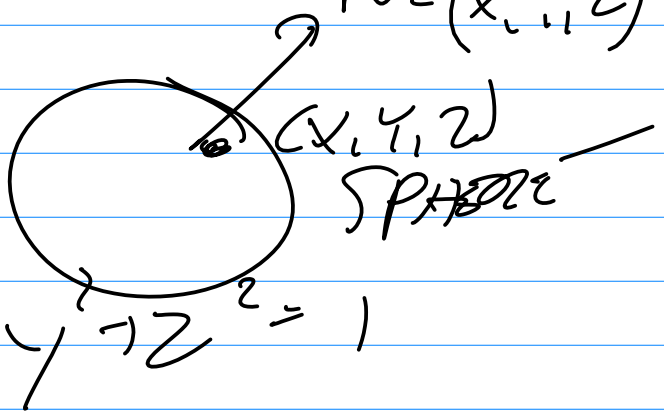
DIFFUSE BRIGHTNESS OF PIXEL IS

$V_{DIF,R} * L_{DIF,R} * \cos\theta$ ETC FOR G, B

Q: WHAT IS NORMAL TO THAT POINT OF SURFACE?

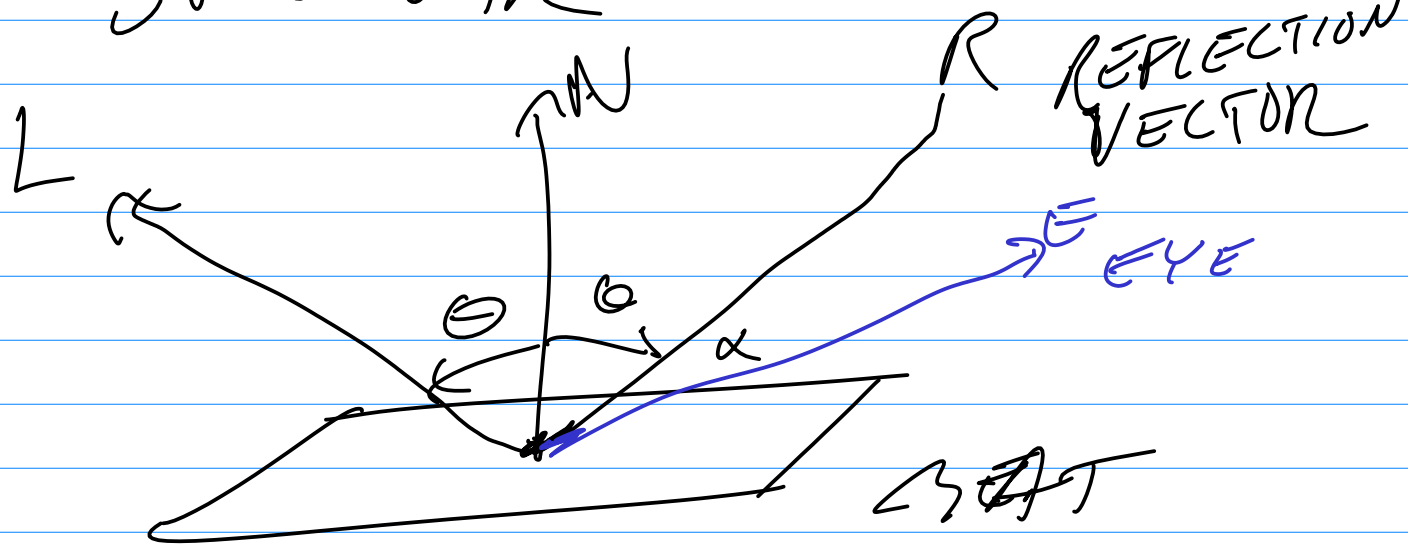
A: CROSS PRODUCT OF TANGENT VECTORS

A_2 - - -



3rd TYPE OF LIGHT

SPECULAR



CLOSER E IS TO R: BRIGHTER.

FACTOR IS $(R \cdot E)^f$

f: 1 → 100 SHININESS COEFFICIENT
HIGHER → SHINIER.

$R \cdot E = \cos\alpha$ IF $|R| = |E| = 1$

$f = 0$ → NO SHININESS
$= 100$ MIRROR
$5 - 10$ SOMEWHAT

BRIGHTNESS OF THAT PIXEL FROM SPECULAR COMPONENT

$V_{SPEC,R} \cdot L_{SPEC,R} \cdot \cos(R,E)^f$ ETC FOR G,B

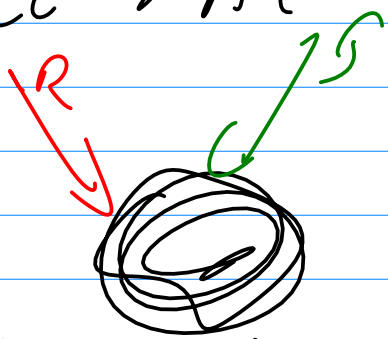
A PHOTON IS NOT DIFFUSE OR SPECULAR.

HAVING SEPARATE COLORS FOR DIF, SPEC LIGHTS IS A HACK TO GIVE DESIGNER MORE PARAMETERS.

SO FAR 9 LIGHT PARAMETERS

$$\begin{bmatrix} L_{AM,R} & L_{AM,G} & L_{AM,B} \\ L_{DIF,R} & L_{DIF,G} & L_{DIF,B} \\ L_{SPI,R} & L_{SP,G} & L_{SP,B} \end{bmatrix}$$

FOR EACH LIGHT. THERE MAY BE SEVERAL LIGHTS



THERE ARE EVEN MORE LIGHT PARAMETERS

- LOCATION OF EACH LIGHT
- OPTIONAL $1/R^2$ FALLOFF

→ 16 PARAMETERS / LIGHT.

FURTHER IT'S A SPOTLIGHT

SPOTLIGHT

5

OPENGL HAS ≥ 8 LIGHTS

MATERIALS 10 PARAMETERS

$\left(V_{AM,R},\ V_{AM,G},\ V_{AM,B},\ V_{DIF,R},\ V_{SP,R} \right)$ + 5

(10)

- THESE MIGHT VARY PIXEL BY PIXEL.
- HAVEN'T SEEN TEXTURES.

TOTAL BRIGHTNESS @ PIXEL

SUM FOR EACH LIGHT:

AMBIENT + DIFFUSE + SPECULAR BRIGHTNESS

+ EMISSIVE BRIGHTNESS

MATERIAL MIGHT BE GLOWING.

→ 13 PARAMS FOR MATERIAL.

THAT WAS GENERAL. NEXT IS OPENGL

SPHERE In Box 1.CPP p426

PROGRAM SPECIFIES A NORMAL VECTOR AT EACH VERTEX OF BOX.
HOWEVER BOX CORNERS DON'T REALLY HAVE NORMALS. IGNORE IT.
SPECIFY AN AVERAGE OF NORMALS OF ADJACENT FACES @ CORNER.

OPENGL USES THESE VERTEX NORMALS TO INTERPOLATE A NORMAL @ EACH PIXEL. THEN APPLIES LIGHTING EQUATION TO THAT NORMAL.

ABOVE SENTENCE DEPENDS ON SOME OPENGL SETTINGS

OPENGL HAS SEVERAL LEVES OF LIGHTING SOPHISTICATION.

1. WHOLE FACE IS THE ONE COLOR YOU SET.

2. a) YOU SPECIFY VERTEX COLORS.
   b) OPENGL BILINEARLY INTERPOLATES COLOR @ EACH PIXEL.

3 a) YOU SPECIFY VERTEX NORMALS.
   b) OPENGL COMPUTES COLOR OF EACH VERTEX
   c) INTERPOLATES COLOR @ EACH PIXEL — GOURAUD SHADING

4 a) YOU SPECIFY VERTEX NORMALS.
   b) OPENGL INTERPOLATES NORMAL @ EACH PIXEL.
   c) OPENGL COMPUTES COLOR @ EACH PIXEL. — PHONG SHADING