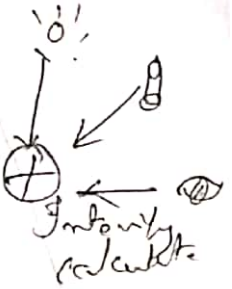
Illumination Model — It is used to calculate intensity / Lighting / Shading of light at surface of the object.

Light Sources — (i) Point Source (Sun)

(ii) Distributed Light Source



Light Absorb Reflect

Shiny Surface

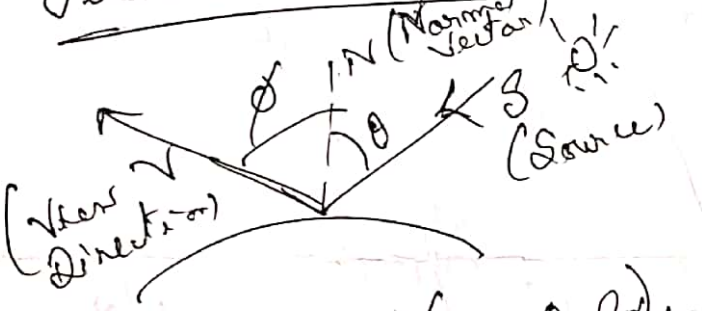
Grainy

Reflection —

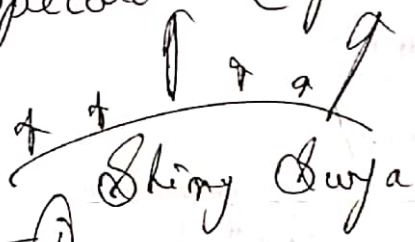
(i) Diffuse Reflection

Rough/Grainy Surface

Illumination Model —



(ii) Specular Reflection

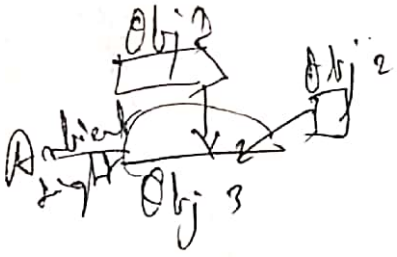


Shiny Surface

$$I_{diffuse} = f(S_L, \theta, \rho) + A(r) \quad \text{— (1)}$$

ρ — Reflectivity coefficient

A — Ambient light



For Ideal Diffuse Reflector also called Lambertian Reflector

$$I_{diff.} = f(\theta, \rho, S_L) + A(r) \quad \text{— (2)}$$

$$I_{diff.} = K_d I_a$$

I_a → Ambient Light Intensity

K_d → Diffuse Reflection Coefficient

K_d near to 1 — Reflection More (Max light Absorb & Reflection low)

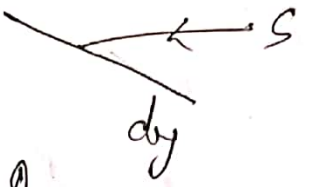
— 0 (Max light Absorb & Reflection low)

Intensity by light Source (Point Light Source) (3)

$I_{l,diff.} = K_d \cdot I_l \cos\theta$

↓

Lambert's Law



Total

$I_{diff.} = K_d I_a + K_d I_l \cos\theta$

$= K_a I_a + K_d I_l \cos\theta$

↑

Ambient light coefficient

Illumination — How to color single point

Shading — ——— full object

Flat Shading —

- One light calculation per polygon
- Each entire polygon drawn with same color.
- Color is computed once for each polygon.

Drawback —

Match Band Effect

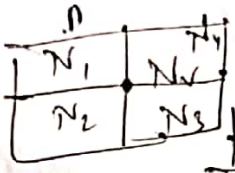
Intensity Color Change

Gouraud Shading —

(i) → Intensity Calculate by any Illumination Model
Flat Shading

(ii) Intensity Interpolation Scheme

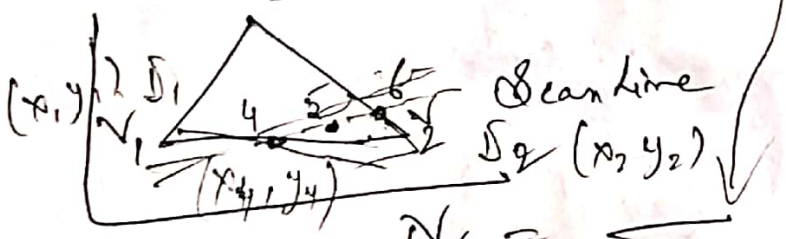
Step 1 — To obtain Average Unit Normal Vector



$$N_V = \frac{\sum_{k=1}^{n} N_k}{\left| \sum_{k=1}^{n} N_k \right|}$$

2 Apply Illumination Model for calculating intensity.

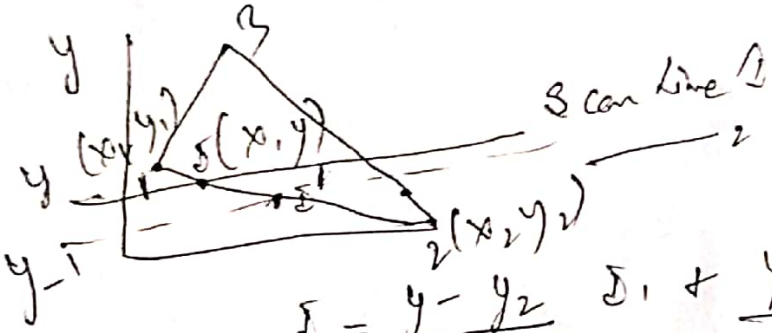
3 Apply Intensity Interpolation



(1) For 1 & 2

(2) Apply illumination model to calculate intensity over the average normal vertices. (V_1, V_2)

(3) $$I = \frac{y_4 - y_2}{y_1 - y_2} I_1 + \frac{y_1 - y_4}{y_1 - y_2} I_2$$



$$I = \frac{y - y_2}{y_1 - y_2} I_1 + \frac{y_1 - y}{y_1 - y_2} I_2 \quad \text{— (1)}$$

$y = y - 1$

$$I' = \frac{(y-1) - y_2}{y_1 - y_2} I_1 + \frac{(y_1) - (y-1)}{y_1 - y_2} I_2$$

$$= \frac{y - y_2 - 1}{y_1 - y_2} I_1 + \frac{y_1 - y + 1}{y_1 - y_2} I_2$$

$$= \frac{y - y_2}{y_1 - y_2} I_1 - \frac{I_1}{y - y_2} + \frac{y_1 - y}{y_1 - y_2} I_2 + \frac{I_2}{y_1 - y_2}$$

$$I' = I + \frac{I_2 - I_1}{y_1 - y_2}$$

Adv. - No Intensity Discontinuity

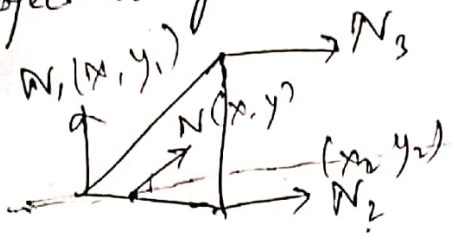
Disadv. - Mach Band (Bright Streak)

Phong Shading → Comes under Interpolation Scheme of Rendering

Steps - (1) Determine average normal vector at each vertex.

Step - ② Linearly interpolate per pixel normal across surface.

③ Apply Illumination model for calculating intensity of projected pixel.



$$N = \frac{y - y_2}{y_1 - y_2} N_1 + \frac{y_1 - y}{y_1 - y_2} N_2$$

$N' =$

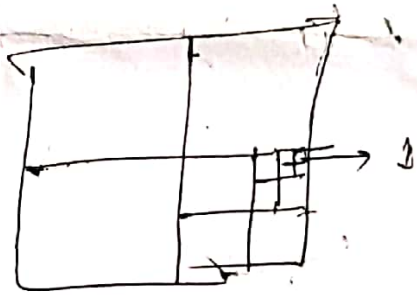
Area Subdivision Method

→ Image Space

Object Space

Divided into Area

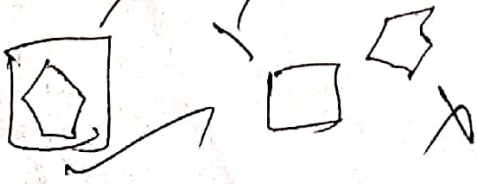
Surface / No Surface

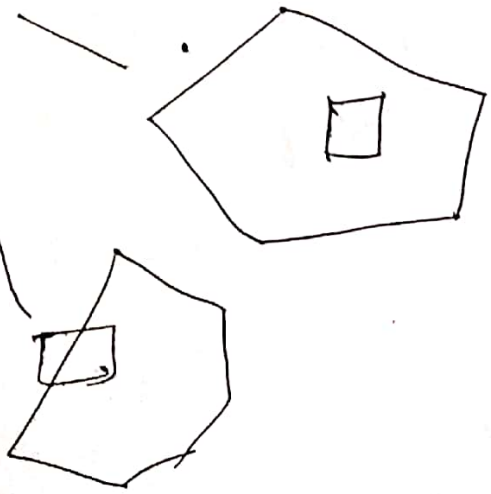


If Surface divide

Surface boundary compared with Area boundary

1) Surrounding Surface
2) Overlapping "
3) Inside Surface
4) Outside "





Check for overlapping →

Depth buffer →