Practice Final

1. Suppose we have a black & white screen. To represent gray-scales we are using ordered dithering with the D_3 matrix. Consider the point (20, 23) which is supposed to be colored with intensity $I=5$. Would this pixel be turn on or off in this set-up? Explain

$$D_3 = \begin{bmatrix} 7 & 2 & 6 \\ 4 & 0 & 1 \\ 3 & 8 & 5 \end{bmatrix}$$

$j = (x \bmod n) + 1$

$k = (y \bmod n) + 1$

$x = 20 \quad y = 23 \quad n = 3$

$j = (20 \bmod 3) + 1 = 3$ $\qquad$ $k = (23 \bmod 3) + 1 = 3$

if $I > D_n(j, k)$ pixel (x, y) is <u>ON</u>

since

$5 \overset{?}{>} D_3(3, 3)$

$5 \not> 5$ NO!

$\therefore$ pixel is <u>off</u>

(2) (a) constant-intensity surface rendering.
(flat surface rendering.)

⇒ Assign same color and intensity to all points on the same surface

(b) Gouraud shading
(intensity-interpolation surface rendering)

⇒ linearly interpolates vertex intensity values across the polygon faces of an illuminated object

At any vertex position V, the normal is:

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

The intensity I on scan line - y

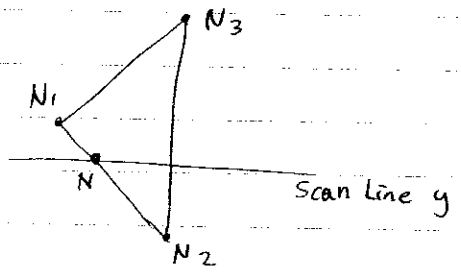
$$I = I_1 + \frac{I_2 - I_1}{y_1 - y_2}$$

(c) Phong shading
(normal-vector interpolation rendering)

⇒ Interpolates normal vectors instead of intensity

The normal N at scan line y

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



GABRIEL LADEN

3.) RAY-SPHERE INTERSECTION

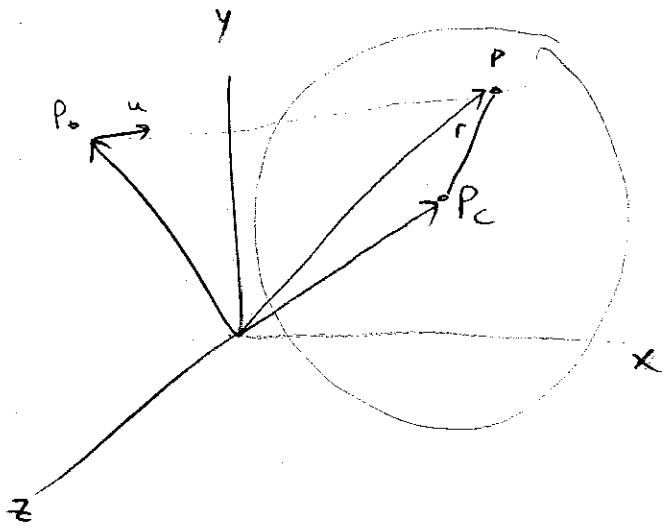
ANY POINT ON SPHERE SATISFIES $|P - P_c|^2 - r^2 = 0$

substitute ray equation $P = P_0 + su$, and find intersection

by solving for $s = (u \cdot \Delta P) \pm \sqrt{r^2 - |\Delta P - (u \cdot \Delta P)u|^2}$

where $\Delta P = P_c - P_0$

* MAKE SURE DISCRIMINANT > 0, ELSE NO INTERSECTION
* TAKE SMALLER OF TWO VALUES FOR s, (NEARER)



(4)

(A) SHADOW RAY:

WHEN USING RAY TRACING, THE RAY BETWEEN A SURFACE POINT AND LIGHT SOURCE TO CHECK IF THERE IS AN OBSTRUCTING SURFACE; IF WE DETECT AN OPAQUE SURFACE IN BETWEEN BOTH POINTS, IGNORE LIGHT SOURCE.

(B) CIRCLE OF CONFUSION:

TO MAKE A POINT AT distance d from the lens be in focus we position the image plane at position d_i

IF POINTS AT $D' > D$, POINTS ARE IN FOCUS IN FRONT OF IMAGE PLANE

IF POINTS AT $D' < D$, POINTS ARE IN FOCUS BEHIND IMAGE PLANE

f = focal length

r = lens radius

POINTS WILL PROJECT AS A SMALL CIRCLE

$$\text{RADIUS} = 2r_c = |d' - d| * f/n * d$$

(C) DISTRIBUTED RAY TRACING:

A TECHNIQUE TO GET A MORE ACCURATE INTENSITY VALUE OF A PIXEL USING THE SPACE SUBDIVISION METHOD AND ADDING A RANDOM JITTER NOISE TO EACH RAY WE SHOOT OUT.

#5 ~~Since $\sum_{k=1}^{n} F_{j,k} = 1$ for all j and $F_{j,j} = 0$ for all j, $F_{1,2} = 1$~~

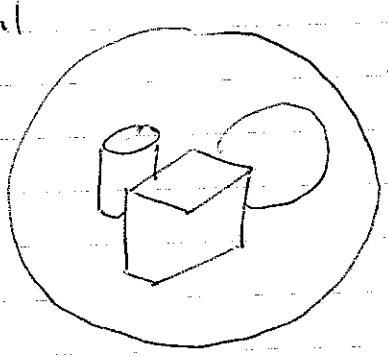
$\phi_1 = \pi/4 \quad \phi_2 = \pi/4 \quad A_2 = 4 \quad d = \sqrt{2}$

$F_{1,2} \approx (\cos \pi/4)(\cos \pi/4)\, 4/(\pi 2)$

$= (1/\sqrt{2})(1/\sqrt{2})\, 4/2\pi = 1/\pi$

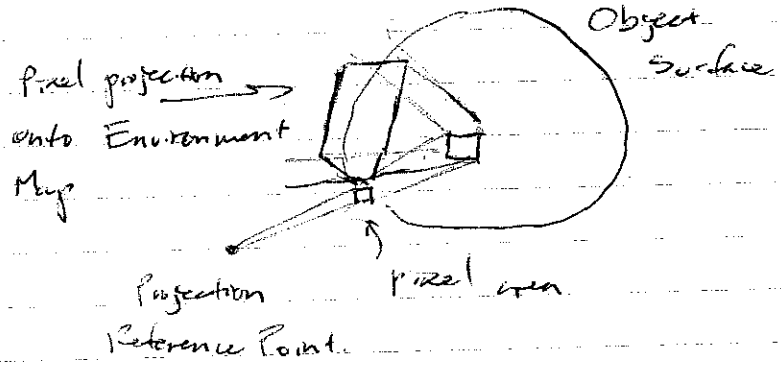
6. Briefly explain how reflection mapping works?

Reflection Mapping is sometimes referred to as Environment Mapping.
Used to model global reflections.
An environment array is mapped onto an object in relationship to the viewing direction.
The environment map includes intensity values for light sources, the sky and background objects.
~~The objects~~
The objects are enclosed in a universe, which can be spherical



Spherical Environment Map.

The surface of an object is rendered by projecting the pixel areas onto the object surface and then reflect each projected pixel area onto the environment map to pick up the surface intensity values for the pixel.



#7

Yuriy Romanenko

- Mip mapping is having a set of lower resolution versions of a texture that are averaged to get the desired resolution. It is mainly a performance enhancing system.

- Bump mapping uses a special bitmap called a bump map that is multiplied by the model normal at every point to produce a rough aspect to the model, akin to a texture that responds to shading.

CS 116B PRACTICE FINAL

#8

```
glTexImage2D(GL_TEXTURE_2D, 0, GL_RGBA,
             texWidth, texHeight, 0, dataFormat,
             dataType, myTexArray);
glEnable(GL_TEXTURE_2D);
```

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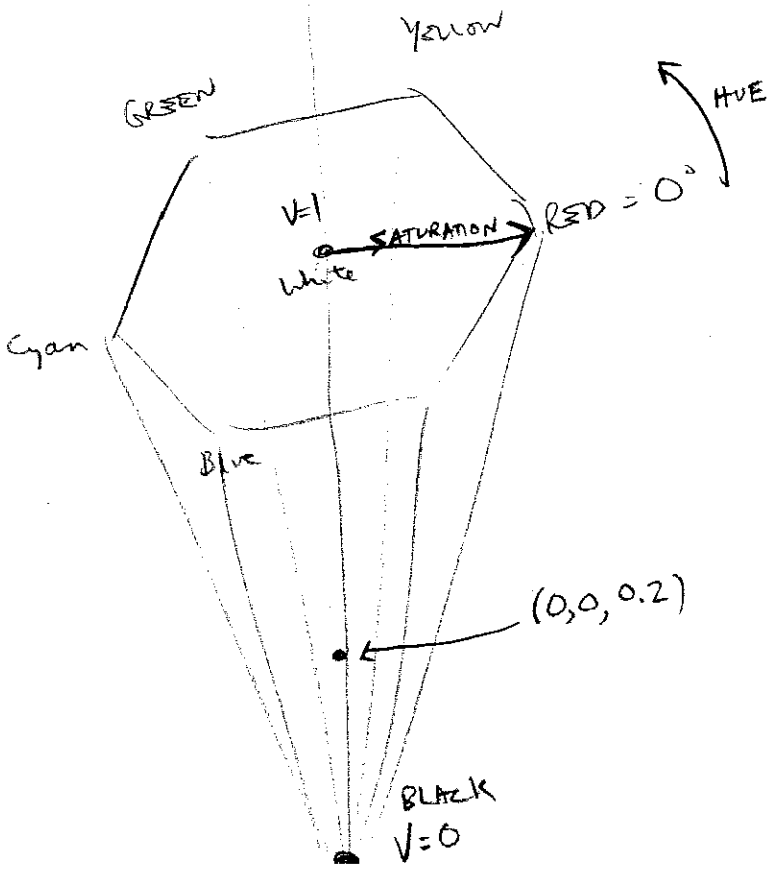
9. CONVERT RGB (50, 50, 50) TO HSV

H = Hue
S = Saturation
V = Value

$HSV = (0, 0, 0.2)$

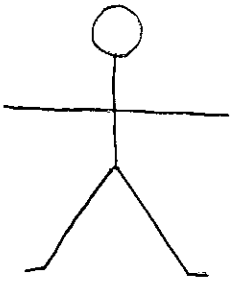
* Since this color is a gray tone r = g = b, it has no hue, (or it is arbitrary)
* Saturation ranges from 0 to 1 from center to edge of HEXAGON
* Value ranges from 0 to 1 from black to white

$\frac{50}{255} = \frac{1}{5} = 0.2$

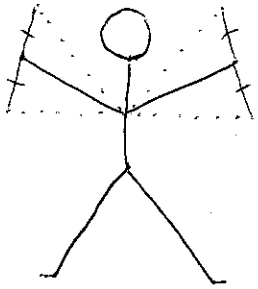


Kristian Klibo

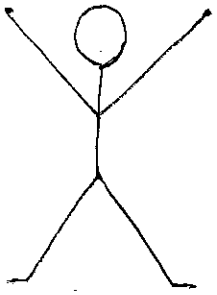
10. Key-framing is an animation technique in which keyframes, representing the locations of vertices in a model at a given time, are used to define an animation sequence. Vertex locations are linearly interpolated between frames to get a model definition at a given time.



t = 0
keyframe



interpolated



t = 1
keyframe