1

PHONG MODEL:

$$I_{SPEC} = w(\theta)\, I \cos^n \phi$$

where

$w(\theta)$ = specular reflection coefficient

ϕ is angle from reflected incident light

can increase n for shinier surfaces

THE PHONG MODEL IS USED AS A LIGHTING MODEL TO DISPLAY SPECULAR LIGHTING. IT IS USEFUL SINCE IT CAN BE MODIFIED TO SUIT DIFFERENT SURFACES BY CHANGING $w(\theta)$ AND n.

2. $P_{ref} = (2, 3, 4)$ $\qquad$ $P_0 = (6, 9, 12)$

$$N = P_{ref} - P_0 = \langle -4, -6, -8 \rangle$$

$$V = \langle 0, 1, 0 \rangle$$

$$n = \frac{N}{\|N\|} = \frac{\langle -4, -6, -8 \rangle}{\sqrt{(-4)^2 + (-6)^2 + (-8)^2}} = \frac{\langle -4, -6, -8 \rangle}{2\sqrt{29}}$$

$$= \left\langle \frac{-2}{\sqrt{29}}, \frac{-3}{\sqrt{29}}, \frac{-4}{\sqrt{29}} \right\rangle$$

$$u = \frac{V \times n}{\|V\|} = \frac{\langle 0, 1, 0 \rangle \times \left\langle \frac{-2}{\sqrt{29}}, \frac{-3}{\sqrt{29}}, \frac{-4}{\sqrt{29}} \right\rangle}{1} = \left\langle \frac{2}{\sqrt{29}}, 0, \frac{4}{\sqrt{29}} \right\rangle$$

$$v = n \times u = \left\langle \frac{-2}{\sqrt{29}}, \frac{-3}{\sqrt{29}}, \frac{-4}{\sqrt{29}} \right\rangle \times \left\langle \frac{2}{\sqrt{29}}, 0, \frac{4}{\sqrt{29}} \right\rangle =$$

$$= \left\langle \frac{12}{29}, 0, \frac{-6}{29} \right\rangle$$

$$\begin{bmatrix} u_x & u_y & u_z & 0 \\ v_x & v_y & v_z & 0 \\ n_x & n_y & n_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -x_0 \\ 0 & 1 & 0 & -y_0 \\ 0 & 0 & 1 & -z_0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{-4}{\sqrt{29}} & 0 & \frac{2}{\sqrt{29}} & 0 \\ -4 & -6 & -8 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -6 \\ 0 & 1 & 0 & -9 \\ 0 & 0 & 1 & -12 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

#3 Clipping window
(10, 10) (100, 100)

$$M_{window,\, normsquare} = \begin{bmatrix} \dfrac{2}{xwmax - xwmin} & 0 & -\dfrac{xwmax + xwmin}{xwmax - xwmin} \\ 0 & \dfrac{2}{ywmax - ywmin} & -\dfrac{ywmax + ywmin}{ywmax - ywmin} \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \dfrac{2}{100-16} & 0 & -\dfrac{100+10}{100-10} \\ 0 & \dfrac{2}{100-16} & -\dfrac{100+10}{100-10} \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1/45 & 0 & -11/9 \\ 0 & 1/45 & -11/9 \\ 6 & 0 & 1 \end{bmatrix}$$

#4

<u>set viewport:</u>

glViewPort(xvmin, yvmin, vpWidth, vpHeight)

<u>position window:</u>

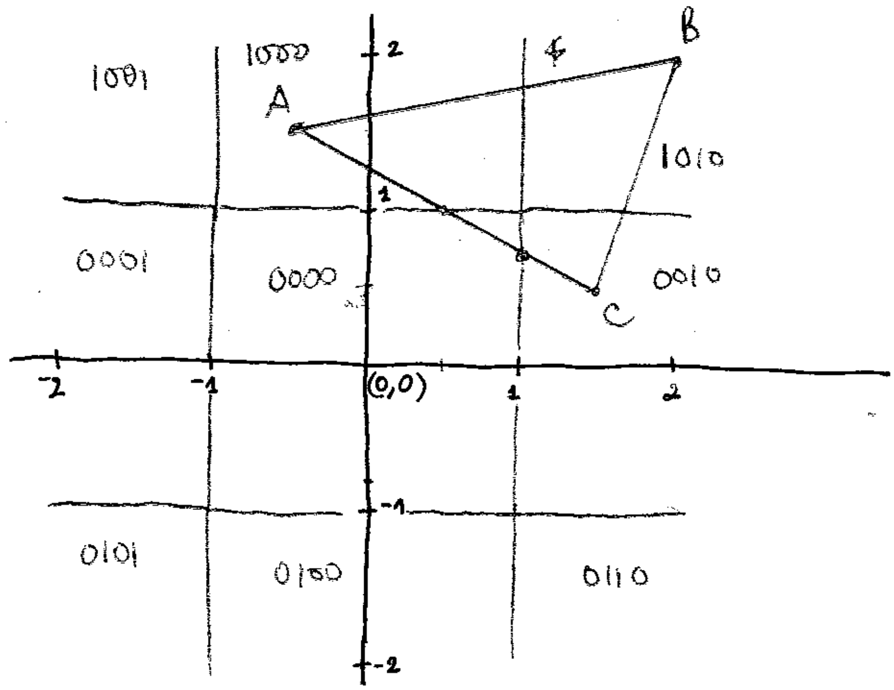
glutInitWindowPosition (xTopLeft, yTopLeft)

glutPositionWindow (xNewTopLeft, yNewTopLeft)

<u>Resize window:</u>

glutReshapeWindow (width, height)

5



AC (1000, 1010) - outside (AND gives 1 in 1st bit)

BC (0010, 1010) - outside (AND gives 1 in 3rd bit)

AB (1000, 0010) - unknown

$m = \frac{1.5 - 0.5}{-0.5 - 1.5} = -\frac{1}{2}$

$y = y_0 + m(x - x_0)$

$= 0.5 + m\ (x - 1.5)$

$= 0.5 + (-0.5)(1 - 1.5)$

$= 0.5 + (0.5)(-0.5)$

$y = 0.5 + 0.25 = 0.75$

$x = x_0 + \frac{y - y_0}{m}$

$= 1.5 + \frac{(0.75 - 0.5)}{-0.5}$

$= 1.5 + \left(-\frac{.25}{0.5}\right) = 1$

p1 (1, 0.75)

$y = y_0 + m(x - x_0)$

$= 1.5 + (-0.5)(x - (-0.5))$

$1 = 1.5 + (-0.5)(x + 0.5)$

$-0.5 = -.5x - 0.25$

$-0.25 = -0.5x$

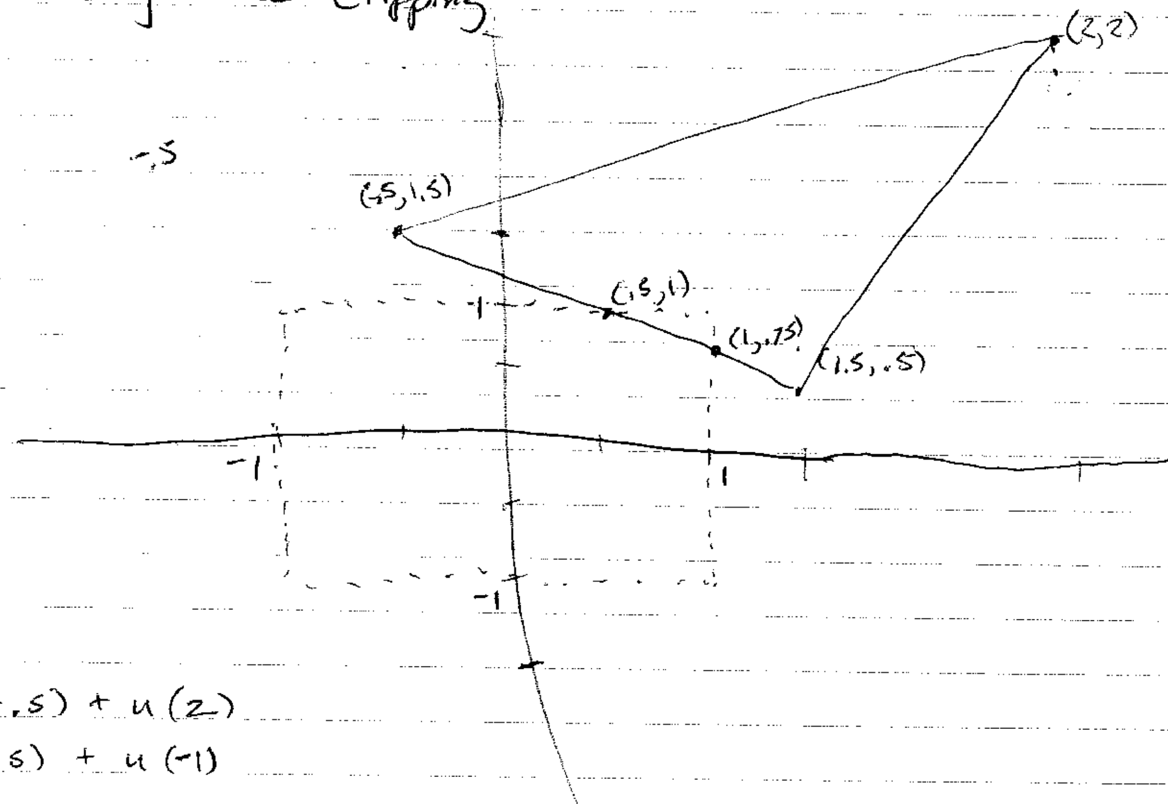
$\frac{1}{2} = \frac{-0.25}{-.5} = x$

$x = x_0 + \frac{y - y_0}{m}$

$= 0.5 + \frac{2.5 - 1.5}{-0.5} = -1.5$

p2(1/2 , 1)

6 Liang-Barsky Line Clipping



$$x = (-.5) + u(2)$$
$$y = (1.5) + u(-1)$$
$$0 \le u \le 1$$

$$-1 \le (-.5) + u(2) \le 1$$
$$-1 \le (1.5) + u(-1) \le 1$$

$$u p_k \le q_k, \quad k = 1, 2, 3, 4$$

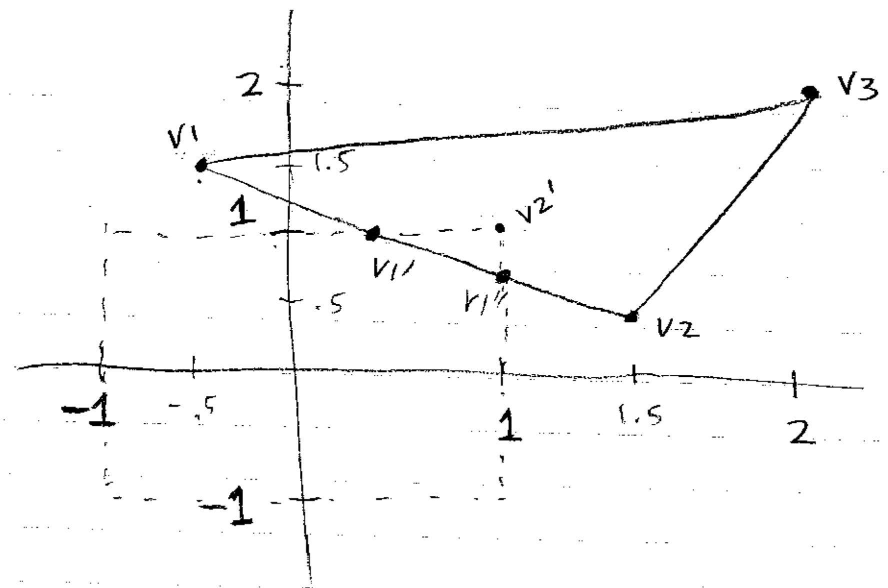
left	$p_1 = -2$	$q_1 = (-.5) - (-1) = .5$	$r_1 = \frac{.5}{-2}$
right	$p_2 = +2$	$q_2 = 1 - (-.5) = 1.5$	$r_2 = \frac{1.5}{2} = .75$
bottom	$p_3 = +1$	$q_3 = (1.5) - (-1) = 2.5$	$r_3 = \frac{2.5}{1} = 2.5$
top	$p_4 = -1$	$q_4 = 1 - 1.5 = -.5$	$r_4 = \frac{-.5}{-1} = .5$

$$u_1 = \max\left(0, \frac{.5}{-2}, .5\right) = .5$$
$$u_2 = \min(1, .75, 2.5) = .75$$

$$x_0 = (-.5) + .5(2) = .5$$
$$y_0 = (1.5) + .5(-1) = 1$$
$$x_{end} = (-.5) + .75(2) = 1$$
$$y_{end} = (1.5) + .75(-1) = .75$$

Calculate p_k, q_k and r_k for the other lines.
If $u_1 > u_2$ for that respective line then it is outside the clipping window and no further calculations are needed.

7



V1 (-.5, 1.5)
V2 (1.5, .5)
V3 (2, 2)

Vertex List

(V1', V1'')

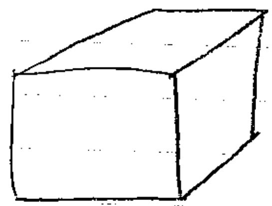
(V1'', V2')

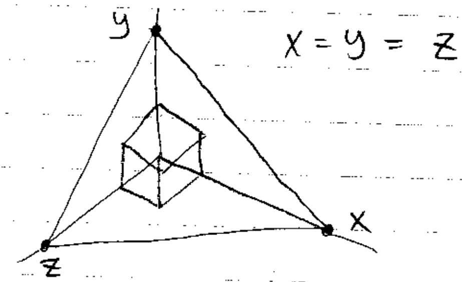
(V2', V1')

Since all input vertices are outside the clipping window, no vertices are sent to the next clipper.

$\Rightarrow$ nothing will be clipped.

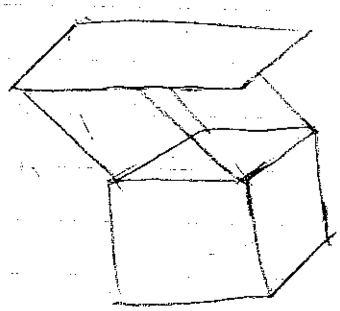
(8) a) Isometric Projection





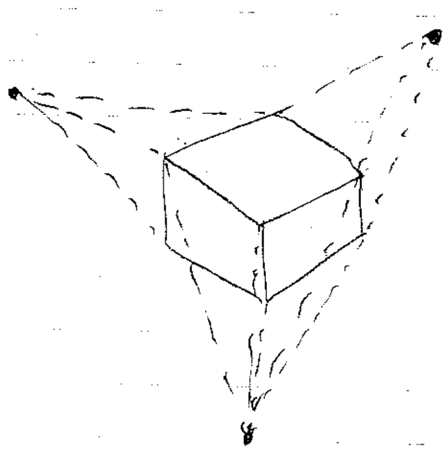
projection is generated by aligning the projection plane, so as to cross each coordinate axis at the same distance.

b) Oblique ~~Orthogonal~~ Parallel projection



Projection path is not perpendicular to view plane

c) 3 principle vanishing points



vanishing point is called Principle vanishing point when the set of line is parallel to one of the axis.

3 Points can be controled by the position of the projection plane

9.)

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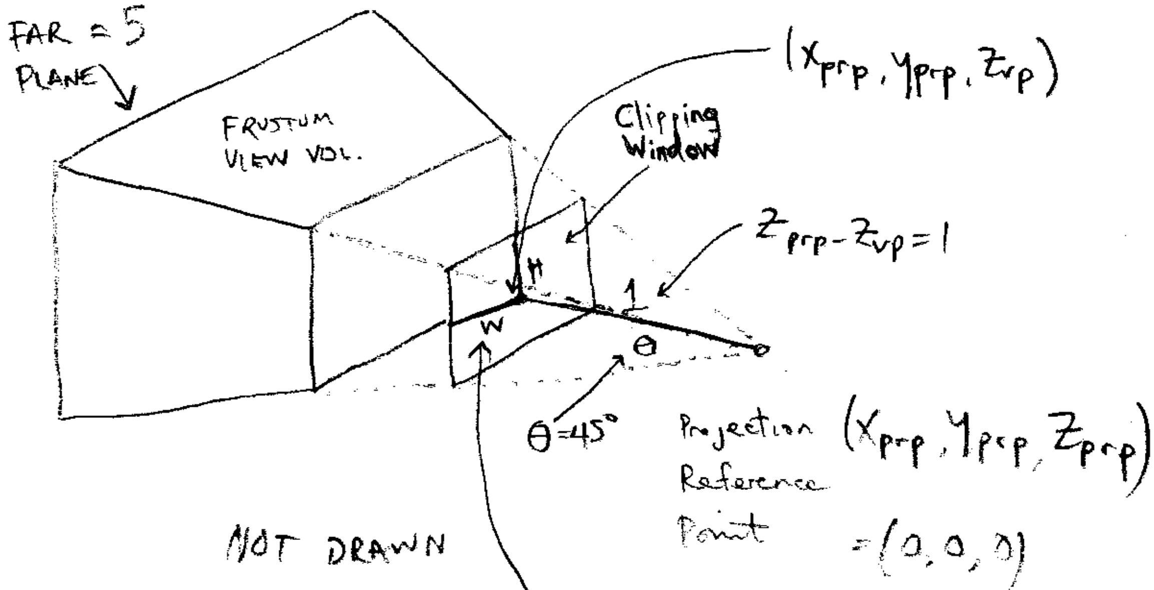
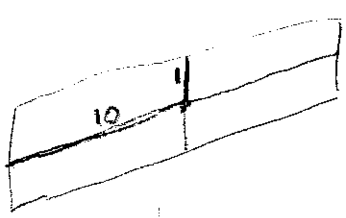
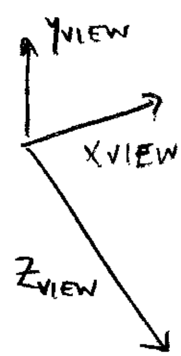
Dennis Arenzona



NOT DRAWN
TO SCALE !

$$\text{ASPECT RATIO} = \frac{\text{WIDTH}}{\text{HEIGHT}} = 10$$





A. Williamson
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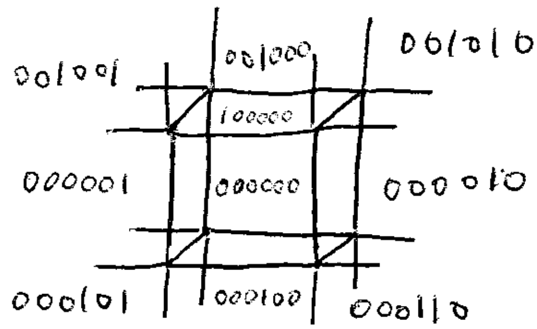
(10) Explain How 3-D region Code Work

The 3-D shape is normalized to a cubic clipping region assigned by a 6 bit binary value.



If the point is inside of the region, all the bits are 0 ie, 000000, depending on where the point is compared to the center region, this will turn on a certain bit.
If above the region the 4th bit is turned on
if below the region the 3rd bit is turned on

Right → 2nd bit
left → 1st bit
near → 5th bit
Far → 4th bit

On Any given position, at most 3 bits maybe turned on at a time.

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