# CSE-413
## MID

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Given : $201x_1 1 x_2 x_3 y_3 z_3$

So,

$x_1 = 7$

$x_2 = 4$

$x_3 = 0$

$y_3 = 1$

$z_3 = 8$

$y_1 = x_1 + 1 = 7 + 1 = 8$

$z_1 = x_1 - 1 = 7 - 1 = 6$

$y_2 = x_2 + 1 = 4 + 1 = 5$

$z_2 = x_2 - 1 = 4 - 1 = 3$

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Ans. to the ques. no.-01(a)

Scanline Algorithm:

Scanline Algorithm is an Image Precision Algorithm and consists of 4 lists:

1) Edge Table
2) Active Edge Table
3) Polygon Table
4) Active Polygon Table.

The Algorithm works like this;

1) First, there are scanlines which are lines along which pixels (each) are displayed (with the polygon colors) are showed.

2) whenever this scanline crosses the First edge we put it in the Active Edge Table and also on the Edge Table. When the scanline crosses that Edge and intersects a new Edge, We remove that

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~~Ed~~ old Edge from the Active Edge Table and put the new Edge on that AET.

3) Similary for Polygon Table and Active polygon Table. whenever the scanline enters a new polygon it is stored in the Polygon Table and Active Polygon Table and The color of that polygon is displayed on the screen.

4) scanline is then moved to the botton of the y-axis and in this manner every pixel of the entire view is displayed on the screen.

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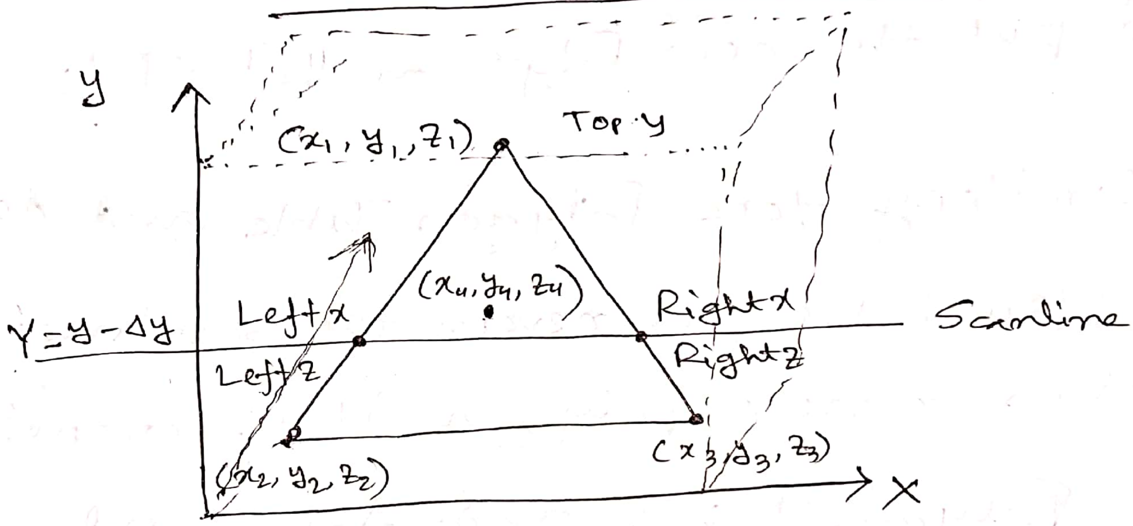
## Ans. to the ques. no. - 01 (b)




The scanline stars from Top y and decrements $\Delta y$ each time decration.

So, $Y = y - \Delta y$.

Now for calculating X :

~~Left X = Left x~~

$$\frac{\text{Left}X - x_1}{x_1 - x_2} = \frac{Y - y_1}{y_1 - y_2} \quad \text{---} \; (1)$$

similarly,

$$\frac{\text{Right}X - x_1}{x_1 - x_3} = \frac{Y - y_1}{y_1 - y_3} \quad \text{---} \; (2)$$

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For calculating the z axis values:

$$\frac{LeftZ - Z_1}{Z_1 - Z_2} = \frac{Y - y_1}{y_1 - y_2} \quad --- \quad (3)$$

and,
$$\frac{RightZ - Z_1}{Z_1 - Z_3} = \frac{Y - y_1}{y_1 - y_3} \quad --- \quad (4)$$

We increment the value of x along the scanline. Lets assume at a particular time the value of $x$ is $X_p$. So, for that time if Z value is $Z_p$ then:

$$\frac{Z_p - LeftZ}{LeftZ - RightZ} = \frac{X_p - LeftX}{LeftX - RightX}$$

So, $$Z_p = LeftZ + (LeftZ - RightZ)\left(\frac{X_p - LeftX}{LeftX - RightX}\right) \quad --- \quad (5)$$

with this equation we can calculate (Au) all the z values for all points on the scanline.

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Now we will put values of $x_1\, x_2\, x_3,\, y_1\, y_2\, y_3$ on the equation for finding values!

From eqn (1):

$$\text{Left } X = x_1 + (x_1 - x_2)\left(\frac{Y - y_1}{y_1 - y_2}\right)$$

$$= 7 + (7 - 4)\left(\frac{Y-8}{8-5}\right)$$

$$= 7 + \cancel{3} \times \frac{Y-8}{\cancel{3}}$$

$$= Y - 1$$

From eqn (2):

$$\text{Right } X = x_1 + (x_1 - x_3)\left(\frac{Y - y_1}{y_1 - y_3}\right)$$

$$= 7 + (7 - 0)\left(\frac{Y-8}{8-1}\right)$$

$$= 7 + \cancel{7} \times \frac{(Y-8)}{\cancel{7}}$$

$$= Y - 1$$

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From eqn 3:

$$\text{Left } z = z_1 + (z_1 - z_2)\left(\frac{Y - y_1}{y_1 - y_2}\right)$$

$$= 6 + (6-3)\left(\frac{Y-8}{8-5}\right)$$

$$= 6 + \cancel{3} \times \frac{Y-8}{\cancel{3}}$$

$$= Y - 2$$

From eqn 4:

$$\text{Right } z = z_1 + (z_1 - z_3)\left(\frac{Y - y_1}{y_1 - y_3}\right)$$

$$= 6 + (6-8)\left(\frac{Y-8}{8-1}\right)$$

$$= 6 + (-2)\frac{Y-8}{7}$$

$$= \frac{42 - 2Y + 16}{7}$$

$$= \frac{58 - 2Y}{7}$$

From eqn 5:

$$z_p = (Y-2) + \left(Y - 2 - \frac{58-2Y}{7}\right)\left(\frac{x_p - Y + 1}{\cancel{Y} - \cancel{1} - \cancel{Y} + \cancel{1}}\right)$$

$$= (Y-2) + \left(\frac{9Y - 72}{7}\right)\left(\frac{x_p - Y + 1}{\text{zero}}\right)$$

$$= Y - 2 \qquad \text{Ans}$$

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Ans. to the ques. no.- 02 (a)

Deriving the equation in Hermite form of a parametric curve:

$Q(t) = [x(t)\ y(t)\ z(t)]$ where, $0 \le t \le 1$

We know,

$Q(t) = T \cdot C$

now, where,

$T = [t^3\ t^2\ t\ 1]$

and if, $C = M \cdot G$

where,

$$M = \text{basis Matrix} = \begin{bmatrix} m_{11} & m_{12} & m_{13} & m_{14} \\ m_{21} & m_{22} & m_{23} & m_{24} \\ m_{31} & m_{32} & m_{33} & m_{34} \\ m_{41} & m_{42} & m_{43} & m_{44} \end{bmatrix}$$

$$G = \text{Geometric Vector} = \begin{bmatrix} G_1 \\ G_2 \\ G_3 \\ G_4 \end{bmatrix}$$

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For Hermite curve:

$$Q(t) = [x(t)\ \ y(t)\ \ z(t)] = T \cdot M_H \cdot G_H$$

where, $G_H$ is $= \begin{bmatrix} P_1 \\ P_4 \\ R_1 \\ R_4 \end{bmatrix}$

So,

$$x(t) = T \cdot M_H \cdot G_{Hx}$$

$$y(t) = T \cdot M_H \cdot G_{Hy}$$

$$z(t) = T \cdot M_H \cdot G_{Hz}$$

where,

$$G_{Hx} = \begin{bmatrix} P_1 \\ P_4 \\ R_1 \\ R_4 \end{bmatrix}_x ;\ G_{Hy} = \begin{bmatrix} P_1 \\ P_4 \\ R_1 \\ R_4 \end{bmatrix}_y ;\ G_{Hz} = \begin{bmatrix} P_1 \\ P_4 \\ R_1 \\ R_4 \end{bmatrix}_z$$

So, $x(t) = T \cdot M_H \cdot G_{Hx}$

$$= \underbrace{(t^3 m_{11} + t^2 m_{21} + t m_{31} + m_{41})}_{A} P_1 x +$$

$$+ \underbrace{(t^3 m_{12} + t^2 m_{22} + t m_{32} + m_{42})}_{B} P_4 x +$$

$$+ \underbrace{(t^3 m_{13} + t^2 m_{23} + t m_{33} + m_{43})}_{C} R_1 x$$

$$+ \underbrace{(t^3 m_{14} + t^2 m_{24} + t m_{34} + m_{44})}_{D} R_4 x$$

Similarly for $y(t)$ and $z(t)$ but only chang in
$P_1x \rightarrow P_1y/P_1z$, $P_4x \rightarrow P_4y/P_4z$, $R_1x \rightarrow R_1y/R_1z$, $R_4x \rightarrow R_4y/R_4z$.

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$y(t) = T \cdot M_H \cdot G_{Hy}$

$= A \cdot P_1 y + B \cdot P_4 y + C \cdot R_1 y + D \cdot R_4 y.$

$z(t) = T \cdot M_H \cdot G_{Hz}$

$= A \cdot P_1 z + B \cdot P_4 z + C \cdot R_1 z + D \cdot R_4 z.$

And, $Q(t) = [x(t) \;\; y(t) \;\; z(t)]$

So, the derivation of $Q(t)$ in terms of $x(t)$, $y(t)$ and $z(t)$ is completed.

(Ans)

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## Ans. to the ques. no. - 02(b)

### (i) Splines :

Splines are piecewise, low-degree polynomial curves. Splines have $C^1$ and $C^2$ continuity at joint points of the curve. and generally do not interpolate the control points.

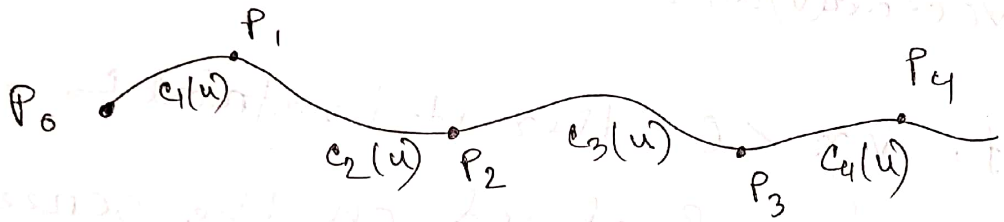


fig : Splines.

Splines are a rich representation. Splines have local effects and interactive sculpting capabilities.

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## (ii) Back-face Culling Algorithm:

Back-face culling Algorithm is an Algorithm where all the faces that are Back-faced from the viewpoint are removed.

Back-faces are removed using the dot product of the viewing vector(V) and normal of the face(n).

if, $v.n < 0$ then it is a front face and is Rendered on the screen

if, $v.n > 0$ then it is a Back-face and is avoided for Rendering.

$v.n < 0$ when, $\theta > 90°$.

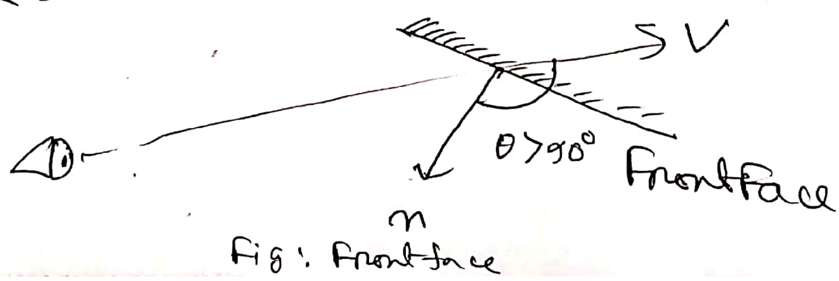


Fig: Front face

13

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$v \cdot n > 0$ when, $\theta < 90°$.

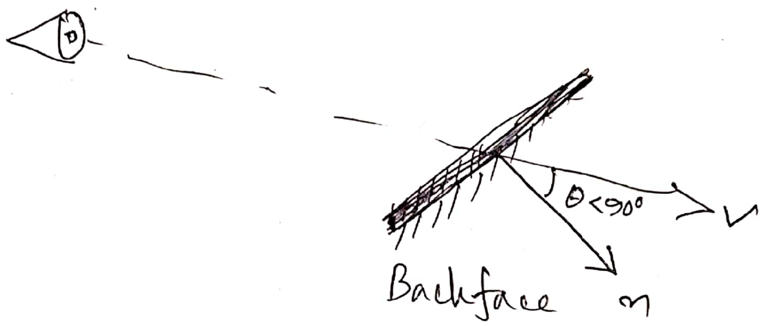


Fig: Back face