Serie de Ejercicios

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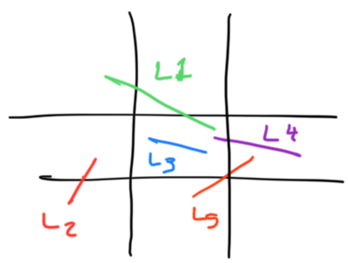
- Computación Gráfica e Interacción Humano Computador

1. Sea el código de asignación ↑ ← ↓ → y las líneas, resolver por método de Cohen Sutherland



⇒

1100	1000	1001
0100	0000	0001
0110	0010	0011

L1) 1100
0000
OR 1100
AND 0000

No se tienen valores ∴ se dibuja //

L2) 0100
0110
0110
0100

AND ≠ 0

∴ se descarta L2 //

L3) 0000
0000
0000

∴ se dibuja L3 //

L4) 0000
0001
OR 0001
AND 0000

AND = 0

No se tienen .

L5) 0001
0010
OR 0011 ← OR ≠ 0
0000
AND = 0

No se tienen valores de límites

limites de valores
∴ se dibuja

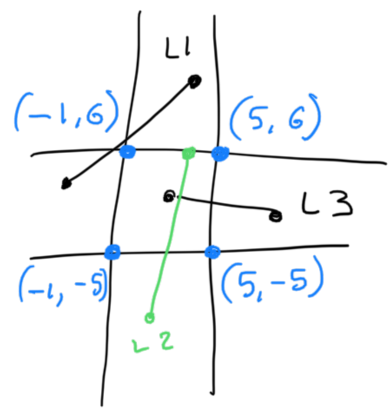
∴ se dibuja

2.- Sea la ventana de recorte con valores Xmin=-1, Y min=-5, Xmax=5, Y max=6, el código de asignación → ↓ ← ↑ y las líneas con vértices:

L1(-3,4), (3,8) L2(2,-6) , (4,6) L3(6,2) , (3,4)

Obtener los puntos de recorte de cada línea por método de Cohen Sutherland.

Trazado de rectas



Código y matriz

0011	0001	1001
0010	0000	1000
0110	0100	1100

L1) 0001
0010
OR 0011

OR≠0
AND 0000
AND=0

//Puntos de recorte
(ventana)

$$X_{izq} = X_{inicial} + m_{izq}(X_{final} - X_{inicial})$$

$$-1 = -3 + m_{izq}(3-(-3))$$

$$2 = m_{izq}(6)$$

$$\frac{1}{3} = m_{izq}$$ continua

$$Y_{izq} = Y_{inicial} + m_{izq}(Y_{final} - Y_{inicial})$$

$$Y_{izq} = 4 + \frac{1}{3}(8-4)$$

$$Y_{izq} = 4 + \frac{4}{3} = \frac{16}{3} \qquad P(-1, 16/3)$$

$$X_{der} = X_{inicial} + m_{der}(X_{final} - X_{inicial})$$

$$5 = -3 + m_{der}(3-(-3))$$

$$8 = m_{der}(6) \; ; \; m_{der} = \frac{8}{6}$$

Pendiente > 1 $\therefore$ No se continua

$$Y_{inf} = Y_{inicial} + m_{inf}(Y_{final} - Y_{inicial})$$

$$-5 = 4 + m_{inf}(8-4)$$

$$m_{inf} = \frac{-9}{4} \quad \therefore \text{ No se continua}$$

$$Y_{sup} = Y_{inicial} + m_{sup}(Y_{final} - Y_{inicial})$$

$$6 = 4 + m_{sup}(8-4)$$

$$\frac{2}{4} = m_{sup} \quad \text{continua}$$

$$X_{sup} = X_{inicial} + m_{sup}(X_{final} - X_{inicial})$$

$$X_{sup} = -3 + \frac{1}{2}(3-(-3)) = -3 + \frac{6}{3} = 0$$

$$P(0, 6)$$

12) 0100
0000
OR 0100
OR ≠ 0
AND 0000

$$Y_{inf} = Y_{inicial} + m_{inf}(Y_{final} - Y_{inicial})$$

$$-5 = -6 + m_{inf}(6-(-6))$$

$$m_{inf} = \frac{1}{12} \quad \text{continua}$$

AND ...
AND $=0$

Puntos

$x_{inf} = x_{inicial} + m_{inf}(x_{final} - x_{inicial})$

$x_{inf} = 2 + \frac{1}{12}(4-2) = 2 + \frac{1}{6} = \frac{13}{6}$

$\therefore P(-5, 13/6)$

$y_{sup} = y_{inicial} + m_{sup}(y_{final} - y_{inicial})$

$6 = -6 + m_{sup}(6 - (-6))$

$m_{sup} = 1 \longrightarrow$ continua

$x_{sup} = x_{inicial} + m_{sup}(x_{final} - x_{inicial})$

$x_{sup} = 2 + 1(4-2)$

$x_{sup} = 2 + 2 = 4$

$\therefore P(4, 6)$

$x_{izq} = x_{inicial} + m_{izq}(x_{final} - x_{inicial})$

$-1 = 2 + m_{izq}(4-2)$

$m_{izq} = -3/2$

$\therefore$ No continua

$x_{der} = x_{inicial} + m_{der}(x_{final} - x_{inicial})$

$5 = 2 + m_{der}(4-2)$

$m_{der} = \frac{3}{2}$

$\therefore$ No continua

L3) 0000
1000
AND 1000

$y_{inf} = y_{inicial} + m_{inf}(y_{final} - y_{inicial})$

$-5 = 4 + m_{inf}(2-4)$

OR ≠ 0

AND 0000

AND = 0

$m_{inf} = \frac{9}{2}$

$\therefore$ No continua

$Y_{sup} = Y_{inicial} + m_{sup}(Y_{final} - Y_{inicial})$

$6 = 4 + m_{sup}(2-4$

$m_{sup} = -1$

$\therefore$ No continua

$X_{izq} = X_{inicial} + m_{izq}(X_{final} - X_{inicial})$

$-1 = 3 + m_{izq}(6-3)$

$m_{izq} = \frac{-4}{3}$ $\therefore$ No continua

$X_{der} = X_{inicial} + m_{der}(X_{final} - X_{inicial})$

$5 = 3 + m_{der}(6-3)$

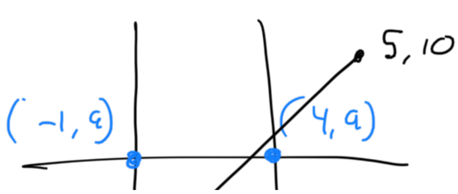
$m_{der} = 2/3$ continua

$Y_{der} = Y_{inicial} + m_{der}(Y_{final} - Y_{inicial})$

$Y_{der} = 4 + \frac{2}{3}(2-4) = \frac{8}{3}$

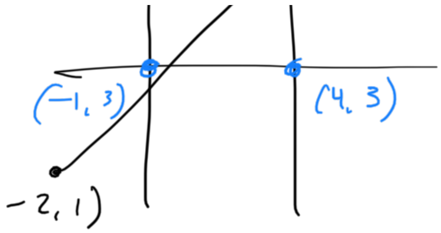
$\therefore P(5, \frac{8}{3})$

3.- Sea la ventana formada por los vértices extremos (-1,3) y (4,9) y la línea formada por los puntos inicial (-2,1) y Punto final(5,10) calcular puntos de recorte por método de Liang Barsky



$Y_{inf} = Y_{inicial} + m_{inf}(Y_{final} - Y_{inicial})$

$3 = 1 + m_{inf}(10-1)$



$$2 = m_{inf}(9)$$

$$m_{inf} = \frac{2}{9}$$

$$x_{inf} = x_{inicial} + m_{inf}(x_{fin} - x_{inicio})$$

$$x_{inf} = -2 + \left(\frac{2}{9}\right)\left(5 - (-2)\right)$$

$$x_{inf} = -\frac{4}{9}$$

$$\therefore P\left(-\frac{4}{9}, 3\right)$$

$$y_{sup} = y_{ini} + m_{sup}(y_{fin} - y_{ini})$$

$$9 = 1 + m_{sup}(10 - 1)$$

$$8 = m_{sup}(9)$$

$$m_{sup} = \frac{8}{9}$$

$$x_{sup} = x_{inicial} + m_{sup}(x_{fin} - x_{ini})$$

$$x_{sup} = -2 + \frac{8}{9}\left(5 - (-2)\right)$$

$$x_{sup} = \frac{38}{9}$$

$$\therefore P\left(\frac{38}{9}, 9\right)$$

$$x_{izq} = x_{ini} + m_{izq}(x_{fin} - x_{ini})$$

$$-1 = -2 + m_{izq}(5 - (-2)$$

$$1 = m_{izq}(7)$$

$$m_{izq} = \frac{1}{7}$$

$$y_{izq} = y_{inicial} + m_{izq}(y_{fin} - y_{ini})$$

$$y_{izq} = 1 + \frac{1}{7}(10 - 1) = \frac{16}{7}$$

$$\therefore P\left(-1, \frac{16}{7}\right)$$

$$x_{der} = x_{ini} + m_{der}(x_{fin} - x_{ini})$$

$$4 = -2 + m_{der}(5 - (-2))$$

$$m_{der} = \frac{6}{7}$$

$$y_{der} = y_{ini} + m_{der}(y_{fin} - y_{ini})$$

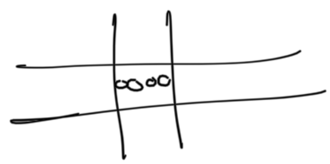
$$y_{der} = 1 + \frac{6}{7}(10 - 1)$$

$$y_{der} = \frac{61}{7}$$

$$\therefore P\left(4, \frac{61}{7}\right)$$

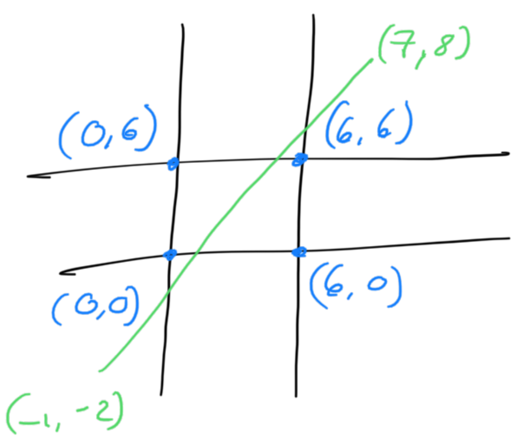
Análisis

$\Rightarrow$ si solo se toman los que pertenecen a 0000



Entonces serán: $P\left(-\frac{4}{9}, 3\right)$ y $P\left(4, \frac{61}{7}\right)$

4.- Sea la recta con origen en el punto (-1,-2) y un vértice en (7,8) Calcular por método de Liang Barsky los puntos de recorte con la ventana formada por los valores Xmin=0, Ymin=0, Xmax= 6, Ymax=6



$$y_{inf} = y_{ini} + m_{inf}(y_{fin} - y_{ini})$$

$$0 = -2 + m_{inf}(8 - (-2))$$

$$2 = m_{inf}(10); \quad m_{inf} = \frac{1}{5}$$

$$x_{inf} = x_{ini} + m_{inf}(x_{fin} - x_{ini})$$

$$x_{inf} = -1 + \frac{1}{5}(7 - (-1))$$

$x_{inf} = \frac{3}{5}$ $\therefore P(\frac{3}{5}, 0)$ //

$y_{sup} = y_{ini} + m_{sup}(y_{fin} - y_{ini})$

$6 = -2 + m_{sup}(8+2)$

$m_{sup} = \frac{4}{5}$

$x_{sup} = x_{ini} + m_{sup}(x_{final} - x_{ini})$

$x_{sup} = -1 + \frac{4}{5}(7 - (-1)) = \frac{27}{5}$

$\therefore P(\frac{27}{5}, 6)$ //

$x_{izq} = x_{ini} + m_{izq}(x_{final} - x_{ini})$

$0 = -1 + m_{izq}(7+1)$

$1 = m_{izq}(8)$; $m_{izq} = \frac{1}{8}$

$y_{izq} = y_{ini} + m_{izq}(y_{fin} - y_{ini})$

$y_{izq} = -2 + \frac{1}{8}(8+2)$

$y_{izq} = -\frac{3}{4}$ $\therefore P(0, -3/4)$ //

$x_{der} = x_{ini} + m_{der}(x_f - x_i)$

$6 = -1 + m_{der}(7+1)$

$m_{der} = \frac{7}{8}$

$y_{der} = y_{ini} + m_{der}(y_f - y_i)$

$y_{der} = -2 + 7/8(8+2)$

$y_{der} = 27/4$ $\therefore P(6, 27/4)$

Análisis

$\Rightarrow$ Los puntos válidos o de recorte serían

$P\left(\frac{3}{5}, 0\right)$ y $P\left(\frac{27}{5}, 6\right)$

5.- Calcular por medio del algoritmo de Bresenham la línea que se dibuja para Punto Inicial(0,0) y punto final(5,7)

Inicial $(0,0)$ $\quad \Delta x = 5$ $\quad 2\Delta y = 14$

Final $(5,7)$ $\quad \Delta y = 7$

$\therefore m = \frac{\Delta y}{\Delta x} = \frac{7}{5}$

if ① $0 \leq |m| \leq 1 \Rightarrow 0 \leq 1.4 \leq 1$ ✗

② $x_1 \leq x_f \Rightarrow 0 < 5$ ✓

Una de las condiciones no cumple

$\therefore$ No se puede dibujar la línea por Bresenham

6.- Obtener la línea por método de Bresenham que se dibuja si se tienen el punto final(5,1) y punto inicial (1,4)

$|\Delta x| = 3$

$$m = \frac{1-4}{5-1} = \frac{-3}{4} \qquad |\Delta x| = 4$$

Nota: Caso especial (Pendiente negativa) Resta en Y

Condiciones

① $x_i < x_f \Rightarrow 1 < 5$

② $0 \leq |m| \leq 1 \Rightarrow 0 \leq \frac{3}{4} \leq 1$

$$P(x_0, y_0) = (1, 4)$$

$$P_0 = 2|\Delta y| - |\Delta x| = 2(3) - 4 = 2$$

$\rightarrow j = 0$ $\quad \left. \begin{matrix} j < dx \\ 0 < 4 \end{matrix} \right\} P_0 \geq 0$

$$P_1(x_0 + 1, y_0 - 1) = (2, 3)$$

$$P_1 = p_0 + 2|\Delta y| - 2|\Delta x| = 2 + 2|3| - 2|4| = 0$$

$\rightarrow j = 1$ $\quad \left. \begin{matrix} j < dx \\ 1 < 4 \end{matrix} \right\} P_1 \geq 0$

$$P_2(x_1 + 1, y_1 - 1) = (3, 2)$$

$$P_2 = P_0 + 2|\Delta y| - 2|\Delta x| = 2|3| - 2|4| = -2$$

$\rightarrow j = 2$ $\quad \left. \begin{matrix} j < dx \\ 2 < 4 \end{matrix} \right\} P_2 < 0$

$$P_3(x_2 + 1, y_2) = (4, 2)$$

$$P_3 = P_2 + 2|\Delta y| = -2 + 2|3| = 4$$

$\rightarrow j=3 \quad 3<4 \quad \checkmark \quad P_3 \geq 0$

$P_4(X_3+1, Y_3-1) = \underline{(5,1)}\checkmark$

$P_4 = P_3 + 2|\Delta y| - 2|\Delta x| = 4+2|3|-2|4| = 2$

$\rightarrow j=4 \quad 4<4 \; X \quad \therefore$ Termina

Puntos $(X_0, Y_0) = (1,4)$

$(X_1, Y_1) = (2,3)$

$(X_2, Y_2) = (3,2)$

$(X_3, Y_3) = (4,2)$

$(X_4, Y_4) = (5,1)$

7.- Obtener por método de Bresenham la circunferencia con centro en el origen y radio 8

$r=8$ Simetrías: $(0,-8)$, $(8,0)$, $(-8,0)$

$P_0(0,r) = (0,8)$

$X_K \geq Y_K$
(Para finalizar)

$p0 = 1-r = 1-8 = 7$

$p0 < 0$

$P_1 = (X_0+1, Y_0) = (1,8)$

$p1 = p0 + 2X_0 + 3 = -7 + 2(0) + 3 = -4$

$p1 < 0$

$(2,8)$

$P_2 = (x_1+1, y_1) = (2, 8)$

$p2 = p1 + 2(x_1) + 3 = -4 + 2(1) + 3 = 1$

$p2 \geq 0$

$P_3 = (x_2+1, y_2-1) = (3, 7)$

$p3 = p2 + 2(x_2) - 2(y_2) + 5 = -6$

$p_3 < 0$

$P_4 (x_3+1, y_3) = (4, 7)$

$P_4 = p3 + 2(x_3) + 3 = -6 + 2(3) + 3 = 3$

$p4 \geq 0$

$P_5 (x_4+1, y-1) = (5, 6)$

$p5 = p4 + 2x_4 - 2y_4 + 5 = 3 + 2(4) - 2(7) + 5 = 2$

$p5 \geq 0$

$P_6 (x_5+1, y_5-1) = (6, 5)$

$p6 = p5 + 2x_5 - 2y_5 + 5 = 2 + 2(5) - 2(6) + 5 = 5$

$x_K \geq y_K \quad 6 \geq 5 \quad \therefore$ Finaliza

Pontos

(0, 8)	(1, 8)	(2, 8)	(3, 7)	(4, 7)	(5, 6)
(0, -8)	(1, -8)	(2, -8)	(3, -7)	(4, -7)	(5, -6)
(8, 0)	(-1, 8)	(-2, 8)	(-3, 7)	(-4, 7)	(-5, 6)
(-8, 0)	(-1, -8)	(-2, -8)	(-3, -7)	(-4, -7)	(-5, -6)
	(8, 1)	(8, 2)	(7, 3)	(7, 4)	(6, 5)
	(8, -1)	(8, -2)	(7, -3)	(7, -4)	(6, -5)
	(-8, 1)	(-8, 2)	(-7, 3)	(-7, 4)	(-6, 5)
	(-8, -1)	(-8, -2)	(-7, -3)	(-7, -4)	(-6, -5)

8.- Obtener por método de Bresenham la circunferencia de radio 5 y centro en (-2,3)

$P_0\ (0, r) = (0, 5)$ Simetric

$(0,-5), (5,0), (-5,0)$

$p0 = 1 - r = 1 - 5 = -4$

$p0 < 0$

$P_1\ (x_0 + 1, y_0) = (1, 5)$

$p1 = p0 + 2x_0 + 3 = -4 + 2(0) + 3 = -1$

$p1 < 0$

$P_2\ (x_1 + 1, y_1) = (2, 5)$

$p2 = p1 + 2x_0 + 3 = -1 + 2(1) + 3 = 4$

$p2 \geq 0$

$P_3\ (x_3 + 1, y_2 - 1) = (3, 4)$

$p3 = p2 + 2x_2 - 2y_2 + 5 = 4 + 2(2) - 2(5) + 5 = 3$

$p3 \geq 0$

$P_4 (x_3 + 1, y_3 - 1) = (4, 3)$

$p4 = p3 + 2x_3 - 2y_3 + 5 = 3 + 6 - 2(4) + 5 = 6$

$x_4 \geq y_4 \quad 4 \geq 3 \quad \therefore$ Finaliza

Simetrías + Desplazamiento $(-2, 3)$

(-2, 8)	(-1, 8)	(0, 8)	(1, 7)
(-2, 2)	(-1, -2)	(0, -2)	(1, -1)
(3, 3)	(-3, 8)	(-4, 8)	(-5, 7)
(-8, 3)	(-3, -2)	(-4, -2)	(-5, -1)
	(3, 4)	(3, 5)	(2, 6)
	(3, 2)	(3, 1)	(2, 0)
	(-7, 4)	(-7, 5)	(-6, 6)
	(7, 2)	(-7, 1)	(-6, 0)

9.- Obtener la transformación [ST1RxT2] para los puntos:(-3,4), (3,8), (2,-6) , (4,6), (3,4)

Siendo Sx=Δx1=1, Sy=-3, Δy1=Δx2=2, Δy2=-3 Rx=45°

$M_1 = R T_2$

$$M_1 = \begin{bmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} & 0 \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & -3 \\ 0 & 0 & 1 \end{bmatrix} =$$

$$= \begin{bmatrix} \sqrt{2}/2 & -\sqrt{2}/2 & 5\sqrt{2}/2 \\ \sqrt{2}/2 & \sqrt{2}/2 & -\sqrt{2}/2 \\ 0 & 0 & 1 \end{bmatrix}$$

$M_2 = T_1 M_1$

$$M_2 = \begin{bmatrix} 1 & 0 & 1 \\ \cdots \end{bmatrix} \begin{bmatrix} \sqrt{2}/2 & -\sqrt{2}/2 & 5\sqrt{2}/2 \\ \sqrt{2}/2 & \sqrt{2}/2 & -\sqrt{2}/2 \\ \cdots \end{bmatrix} =$$

$$M_2 \quad \begin{bmatrix} 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \sqrt{2}/2 & -\sqrt{2}/2 & \frac{2+5\sqrt{2}}{2} \\ \sqrt{2}/2 & \sqrt{2}/2 & \frac{4-\sqrt{2}}{2} \\ 0 & 0 & 1 \end{bmatrix}$$

$$M_3 = S M_2$$

$$M_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \sqrt{2}/2 & -\sqrt{2}/2 & \frac{2+5\sqrt{2}}{2} \\ \sqrt{2}/2 & \sqrt{2}/2 & \frac{4-\sqrt{2}}{2} \\ 0 & 0 & 1 \end{bmatrix} =$$

$$= \begin{bmatrix} \sqrt{2}/2 & -\sqrt{2}/2 & \frac{2+5\sqrt{2}}{2} \\ \frac{-3\sqrt{2}}{2} & -\frac{3\sqrt{2}}{2} & -3\left(\frac{4-\sqrt{2}}{2}\right) \\ 0 & 0 & 1 \end{bmatrix}$$

$$M_3 P$$

$$\begin{bmatrix} \sqrt{2}/2 & -\sqrt{2}/2 & \frac{2+5\sqrt{2}}{2} \\ \frac{-3\sqrt{2}}{2} & -\frac{3\sqrt{2}}{2} & -3\left(\frac{4-\sqrt{2}}{2}\right) \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} -3 & 3 & 2 & 4 & 3 \\ 4 & 8 & -6 & 6 & 4 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} =$$

$$= \begin{bmatrix} 1-\sqrt{2} & 1 & \frac{2+13\sqrt{2}}{2} & \frac{2+3\sqrt{2}}{2} & 1+2\sqrt{2} \\ -6 & -6-15\sqrt{2} & \frac{-12+15\sqrt{2}}{2} & \frac{12+27\sqrt{2}}{2} & 6-9\sqrt{2} \end{bmatrix}$$

10.- Obtener la transformación [S1RzS2T1] para los puntos (1,1,1), (3,4,1), (-2,-1,-3), (0,0,-1)

Siendo Sx1=Sx2=Sz2=2, Sy1=-1, Sy2=Sz1=1, Δx=-1, Δy=3, Δz=2, Rz=180°

$M_1 = S_2 T_1$

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 & -2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 2 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$M_2 = R_2 M_1$

$$\begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 2 & 0 & 0 & -2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 2 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -2 & 0 & 0 & 2 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 2 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$M_3 = S_1 M_2$

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} -2 & 0 & 0 & 2 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 2 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -4 & 0 & 0 & 4 \\ 0 & -1 & 0 & 3 \\ 0 & 0 & 2 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$M_3 P$

$$\begin{bmatrix} -4 & 0 & 0 & 4 \\ 0 & -1 & 0 & 3 \\ 0 & 0 & 2 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 3 & -2 & 0 \\ 1 & 4 & -1 & 0 \\ 1 & 1 & -3 & -1 \\ 1 & 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 0 & -8 & 12 & -4 \\ 2 & -1 & 4 & 3 \\ 6 & 6 & -2 & 2 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$