

## Primera parte

$\mathbf{A} = [2, 1, 3]$ ,  $\mathbf{B} = [4, 3, 1]$  y  $\mathbf{C} = [3, 2, 4]$

### Escalado

Escala el punto  $\mathbf{A}$  en X, Y y Z por un factor de **1.43**

$$Q = \begin{bmatrix} 1.43 & 0 & 0 & 0 \\ 0 & 1.43 & 0 & 0 \\ 0 & 0 & 1.43 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 2 \\ 1 \\ 3 \\ 1 \end{bmatrix} = (2.86, 1.43, 4.29)$$

$$\mathbf{Q} = [2.86, 1.43, 4.29]$$

### Traslación

Traslada  $\mathbf{Q}$  usando las coordenadas de  $\mathbf{B}$

$$Q = \begin{bmatrix} 1 & 0 & 0 & 4 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 2.86 \\ 1.43 \\ 4.29 \\ 1 \end{bmatrix} = (6.86, 4.43, 5.29)$$

$$\mathbf{Q} = [6.86, 4.43, 5.29]$$

### Rotación con pivote

Rota el punto  $\mathbf{C}$ ,  $45^\circ$  en el eje  $\mathbf{X}$ . Toma como punto pivote al punto  $\mathbf{Q}$ .

$$C = \begin{bmatrix} 1 & 0 & 0 & -6.86 \\ 0 & 1 & 0 & -4.43 \\ 0 & 0 & 1 & -5.25 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 3 \\ 2 \\ 4 \\ 1 \end{bmatrix} = (-3.86, -2.43, -1.29)$$

$$C = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\left(45^\circ \frac{\pi}{180}\right) & -\sin\left(45^\circ \frac{\pi}{180}\right) & 0 \\ 0 & \sin\left(45^\circ \frac{\pi}{180}\right) & \cos\left(45^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -3.86 \\ -2.43 \\ -1.29 \\ 1 \end{bmatrix} = (-3.86, -0.80604, -2.63036)$$

$$C = \begin{bmatrix} 1 & 0 & 0 & 6.86 \\ 0 & 1 & 0 & 4.43 \\ 0 & 0 & 1 & 5.25 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -3.86 \\ -0.80604 \\ -2.63036 \\ 1 \end{bmatrix} = (3, 3.62396, 2.61964)$$

## Segunda parte

Considera una pirámide triangular regular. Su lado  $a = 3.3$  y su altura  $h = \sqrt{\frac{2}{3}}a$  La base de la pirámide está centrada en el punto  $C = (-1.812, -6.824, 5.247)$

**Altura de la piramide:**

$$h = \sqrt{\frac{2}{3}} * 3.3$$

$$h \approx 2.69443871$$

**Vertice A:**

$$A = (-1.812, -6.824, 5.247 + 2.69443871)$$

$$A = (-1.812, -6.824, 7.94143871)$$

**Vertice B:**

$$\partial = \sqrt{(3.3)^2 - \left(\sqrt{\frac{2}{3}} * 3.3\right)^2}$$

$$\partial \approx \sqrt{3.629}$$

$$B = (-1.812, -6.824 + \sqrt{3.629}, 5.247)$$

$$B \approx (-1.812, -4.919, 5.247)$$

**Vertice C:**

$$\partial = \sqrt{(\sqrt{3.629})^2 - (1.65)^2}$$

$$\partial = \sqrt{0.9065}$$

$$C = (-1.812 + 1.65, -6.824 - \sqrt{0.9065}, 5.247)$$

$$C \approx (-0.162, -7.77610293, 5.247)$$

**Vertice D:**

$$D = (-1.812 - 1.65, -6.824 - \sqrt{0.9065}, 5.247)$$

$$D \approx (-3.462, -7.77610293, 5.247)$$

## Segunda parte

Encuentra la nueva posición de cada vértice, cuando la pirámide es rotada respecto al **eje Y**, por **-15°**. Usa como **pivote** el **centroide** de la pirámide (el centroide es el promedio de cada componente de cada vértice).

$$\partial = \sqrt{(\sqrt{3.629})^2 - (1.65)^2}$$

$$\partial = \sqrt{0.9065}$$

$$\text{Centroide} = (-1.812, -6.824, 5.247 + \sqrt{0.9065})$$

$$\text{Centroide} \approx (-1.812, -6.824, 6.19910293)$$

**Vertice A**  $(-1.812, -6.824, 7.941)$

$$A = \begin{bmatrix} 1 & 0 & 0 & 1.812 \\ 0 & 1 & 0 & 6.824 \\ 0 & 0 & 1 & -6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -1.812 \\ -6.824 \\ 7.941 \\ 1 \end{bmatrix} = (0, 0, 1.742)$$

$$A = \begin{bmatrix} \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 & \sin\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\left(-15^\circ \frac{\pi}{180}\right) & 0 & \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 0 \\ 0 \\ 1.742 \\ 1 \end{bmatrix} = (-0.45, 0, 1.682)$$

$$A = \begin{bmatrix} 1 & 0 & 0 & -1.812 \\ 0 & 1 & 0 & -6.824 \\ 0 & 0 & 1 & 6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -0.45 \\ 0 \\ 1.1682 \\ 1 \end{bmatrix} = (-2.262, -6.8244, 7.3672)$$

**Vertice B**  $(-1.812, -4.919, 5.247)$

$$B = \begin{bmatrix} 1 & 0 & 0 & 1.812 \\ 0 & 1 & 0 & 6.824 \\ 0 & 0 & 1 & -6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -1.812 \\ -4.919 \\ 5.247 \\ 1 \end{bmatrix} = (0, 1.905, -0.952)$$

$$B = \begin{bmatrix} \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 & \sin\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\left(-15^\circ \frac{\pi}{180}\right) & 0 & \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 0 \\ 1.905 \\ -0.952 \\ 1 \end{bmatrix} = (0.2463, 1.905, -0.9195)$$

$$B = \begin{bmatrix} 1 & 0 & 0 & -1.812 \\ 0 & 1 & 0 & -6.824 \\ 0 & 0 & 1 & 6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 0.2463 \\ 1.905 \\ -0.9195 \\ 1 \end{bmatrix} = (-1.3473, -0.9521, -1.3466)$$

**Vertex C**  $(-0.162, -7.7761, 5.247)$

$$C = \begin{bmatrix} 1 & 0 & 0 & 1.812 \\ 0 & 1 & 0 & 6.824 \\ 0 & 0 & 1 & -6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -0.162 \\ -7.7761 \\ 5.247 \\ 1 \end{bmatrix} = (1.65, -0.9521, -0.952)$$

$$C = \begin{bmatrix} \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 & \sin\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\left(-15^\circ \frac{\pi}{180}\right) & 0 & \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1.65 \\ -0.9521 \\ -0.952 \\ 1 \end{bmatrix} = (1.8401, -0.9521, -0.4925)$$

$$C = \begin{bmatrix} 1 & 0 & 0 & -1.812 \\ 0 & 1 & 0 & -6.824 \\ 0 & 0 & 1 & 6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1.8401 \\ -0.9521 \\ -0.4925 \\ 1 \end{bmatrix} = (0.02817, -7.7761, 5.7064)$$

**Vertex D**  $(-3.462, -7.7761, 5.247)$

$$D = \begin{bmatrix} 1 & 0 & 0 & 1.812 \\ 0 & 1 & 0 & 6.824 \\ 0 & 0 & 1 & -6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -3.462 \\ -7.7761 \\ 5.247 \\ 1 \end{bmatrix} = (-1.65, -0.9521, -0.952)$$

$$D = \begin{bmatrix} \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 & \sin\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\left(-15^\circ \frac{\pi}{180}\right) & 0 & \cos\left(-15^\circ \frac{\pi}{180}\right) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -1.65 \\ -0.9521 \\ -0.952 \\ 1 \end{bmatrix} = (-1.3473, -0.9521, -1.346)$$

$$D = \begin{bmatrix} 1 & 0 & 0 & -1.812 \\ 0 & 1 & 0 & -6.824 \\ 0 & 0 & 1 & 6.199 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -1.3473 \\ -0.9521 \\ -1.346 \\ 1 \end{bmatrix} = (-3.15938, -7.7761, 4.8523)$$