Lista 1 - Computação Gráfica

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i) $p^* = T'_{obj} \cdot p'$

↳ $T'_{obj} \cdot T_{obj} \cdot p'$

$p' = T'^{-1}_{ob} \cdot p^*$

ii) $p^{**} = T''_{obj} \cdot p'$

↳ $p^* = \underbrace{T''_{obj} \cdot T_{obj}^{-1}}_{T} \cdot p^*$

$$T'_{obj} = T\begin{pmatrix}\frac{1}{2}\\0\end{pmatrix} \cdot \overbrace{R_z(45°) \cdot R_y(-90°)}^{R'} \cdot S\begin{pmatrix}1\\1\\2\end{pmatrix} \quad (I)$$

$$T''_{obj} = T\begin{pmatrix}2\\\frac{1}{2}\\0\end{pmatrix} \cdot \overbrace{R_x(90°) \cdot R_z(-90°)}^{R''} \cdot S\begin{pmatrix}1\\0{,}5\\1\end{pmatrix} \quad (II)$$

$$T'^{-1}_{obj} = S\begin{pmatrix}1\\1\\0{,}5\end{pmatrix} \cdot R'^{T} \cdot T\begin{pmatrix}-1\\-2\\0\end{pmatrix} \quad (III)$$

(I) $T'_{obj} = T\begin{pmatrix}\frac{1}{2}\\0\end{pmatrix} \cdot \underbrace{R_z(45°) \cdot R_y(-90°)}_{R'} \cdot S\begin{pmatrix}1\\1\\2\end{pmatrix}$

- $R_z(45°) \cdot R_y(-90°)$ $\quad R'$

$$R' = \begin{bmatrix}\frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} & 0\\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0\\ 0 & 0 & 1\end{bmatrix} \cdot \begin{bmatrix}0 & 0 & -1\\ 0 & 1 & 0\\ 1 & 0 & 0\end{bmatrix} = \begin{bmatrix}0 & -\frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2}\\ 0 & \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2}\\ 1 & 0 & 0\end{bmatrix}$$

$R_z(45°) \quad \cdot \quad R_y(-90°)$

- $R' \cdot S\begin{pmatrix}1\\\frac{1}{2}\end{pmatrix}$

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

- $T\begin{pmatrix}\frac{1}{2}\\0\end{pmatrix} \cdot R' \cdot S\begin{pmatrix}1\\\frac{1}{2}\end{pmatrix}$

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

Continuação da questão 1

(II) $T\begin{pmatrix}2\\1\\0\end{pmatrix} \cdot \underbrace{R_z(-90°) \cdot R_x(90°)}_{R''} \cdot S\begin{pmatrix}1\\0,5\\1\end{pmatrix}$

- $R_x(90°) \cdot R_z(-90°)$

$$\begin{bmatrix}1&0&0\\0&0&-1\\0&1&0\end{bmatrix} \cdot \begin{bmatrix}0&1&0\\-1&0&0\\0&0&1\end{bmatrix} = \begin{bmatrix}0&1&0\\0&0&-1\\-1&0&0\end{bmatrix}$$

- $R'' \cdot S\begin{pmatrix}1\\0,5\\1\end{pmatrix}$

$$\begin{bmatrix}0&1&0\\0&0&-1\\-1&0&0\end{bmatrix} \cdot \begin{bmatrix}1&0&0\\0&0,5&0\\0&0&1\end{bmatrix} = \begin{bmatrix}0&0,5&0\\0&0&-1\\-1&0&0\end{bmatrix}$$

- $T\begin{pmatrix}2\\1\\0\end{pmatrix} \cdot R_x(90°) \cdot R_z(-90°) \cdot S\begin{pmatrix}1\\0,5\\1\end{pmatrix}$

$$\begin{bmatrix}0&0,5&0&2\\0&0&1&1\\-1&0&0&0\\0&0&0&1\end{bmatrix}$$

(III) $T_{obj}^{1-1} = S\begin{pmatrix}1\\1\\0,5\end{pmatrix} \cdot R'^{T} \cdot T\begin{pmatrix}-1\\-2\\0\end{pmatrix}$

- $S\begin{pmatrix}1\\1\\0,5\end{pmatrix} \cdot R'^{T}$

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

- ~~$S\begin{pmatrix}1\\1\\0,5\end{pmatrix} \cdot R'^{T} \cdot T\begin{pmatrix}-1\\-2\\0\end{pmatrix}$~~

Continuação da questão 1

- $S\begin{pmatrix}1\\1\\0{,}5\end{pmatrix} \cdot R^{1T} \cdot T\begin{pmatrix}-1\\-2\\0\end{pmatrix}$

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

- $T = T'_{obj} \cdot T''^{-1}_{obj}$

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

- p^* e $p^{\#}$ $(p(1,0,0))$

i) $p^* = T'_{obj} \cdot p$

$$p^* = \begin{bmatrix} 0 & -\sqrt{2}/2 & -\sqrt{2} & 1 \\ 0 & \sqrt{2}/2 & -\sqrt{2} & 2 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 1 \\ 1 \end{bmatrix}$$

ii) $p^{\#} = T''_{obj} \cdot p$ ou $p^{\#} = J \cdot p^*$

$$p^{\#} \begin{bmatrix} 0 & 0{,}5 & 0 & 2 \\ 0 & 0 & -1 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ -1 \\ 1 \end{bmatrix}$$

Código OpenGL

$$T = \left(T\begin{pmatrix}2\\1\\0\end{pmatrix} \cdot R'' \cdot S\begin{pmatrix}1\\0{,}5\\1\end{pmatrix} \right) \cdot \left(S\begin{pmatrix}1\\1\\0{,}5\end{pmatrix} \cdot R''^{T} \cdot T\begin{pmatrix}-1\\-2\\0\end{pmatrix} \right)$$

$T = T''_{obj} \cdot T'^{-1}_{obj}$

```
glTranslatef(2,1,0);
glRotatef(90,1,0,0);
glRotatef(-90,0,0,1);
glScalef(1,0.5,1);
glScalef(1,1,0.5);
glRotatef(90,0,1,0);
glTranslatef(-1,-2,0);
glRotate(-45,0,0,1);
```