Virtual Reality Lab Class Winter Term 2018/19

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1 Exercise 1.1 - 1.4

see `vr_assignment1.py`

2 Exercise 1.5

This exercise shows how to find a pair of angles α and β such that the fallowing equation holds:

$$rot(90, x) \cdot rot(\alpha, z) = rot(\beta, y) \cdot rot(90, x)$$

$$\underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{R_x(90°)} \cdot \underbrace{\begin{bmatrix} cos(\alpha) & -sin(\alpha) & 0 & 0 \\ sin(\alpha) & cos(\alpha) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{R_z(\alpha)} \stackrel{!}{=} \underbrace{\begin{bmatrix} cos(\beta) & 0 & sin(\beta) & 0 \\ 0 & 1 & 0 & 0 \\ -sin(\beta) & 0 & cos(\beta) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{R_y(\beta)} \cdot \underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{R_x(90°)}$$

$$\begin{bmatrix} cos(\alpha) & -sin(\alpha) & 0 & 0 \\ 0 & 0 & -1 & 0 \\ sin(\alpha) & cos(\alpha) & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \stackrel{!}{=} \begin{bmatrix} cos(\beta) & -sin(\beta) & 0 & 0 \\ 0 & 0 & -1 & 0 \\ -sin(\beta) & cos(\beta) & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

All places in both matrices are the same with the exception of column 1, row 3. Here we have $sin(\alpha)$ on one side of the equation and $-sin(\beta)$ on the other side. The trivial answer to solve $sin(\alpha) = -sin(\beta)$ for α and β would result in 0. For $\alpha = \beta = 180°$ the equation holds as $sin(180°) = \pm 0$ as does $-sin(180°) = \pm 0$.

3 Exercise 1.6

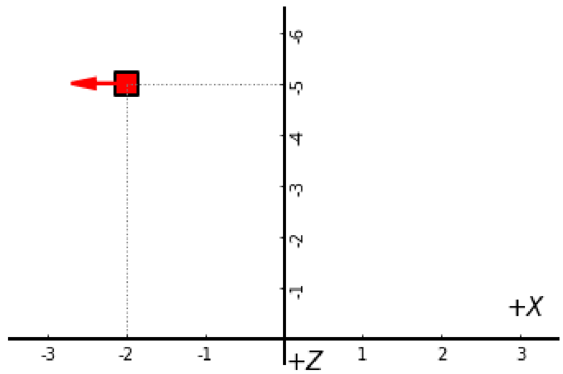

Figure 1: $rot(90, y) \cdot trans(5.0, 0.0, -2.0)$

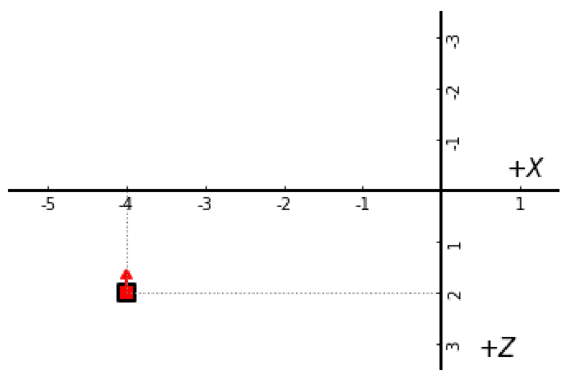

Figure 2: $trans(-4.0, 0.0, 2.0) \cdot scale(0.5)$

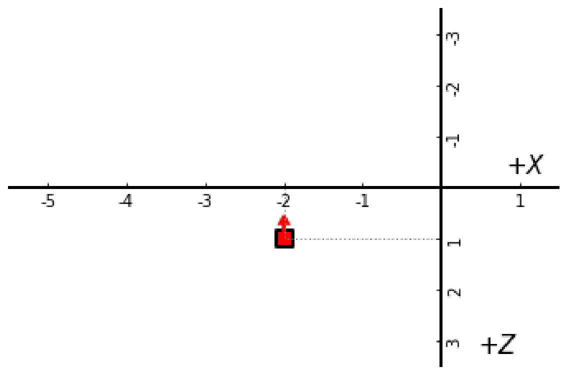

Figure 3: $scale(0.5) \cdot trans(-4.0, 0.0, 2.0)$

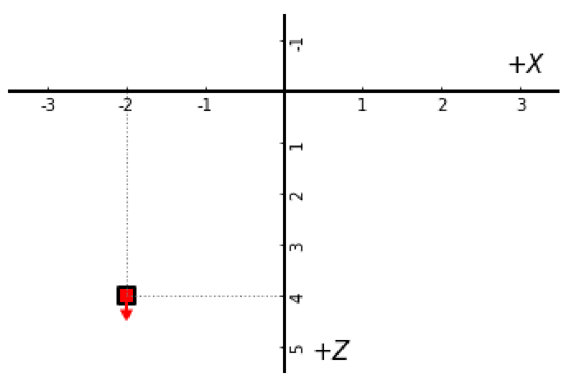

Figure 4: $trans(-2.0, 0.0, 4.0) \cdot scale(0.5) \cdot rot(180, y)$