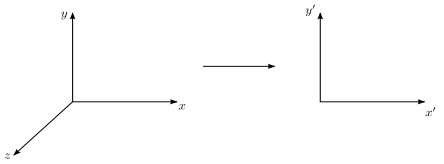
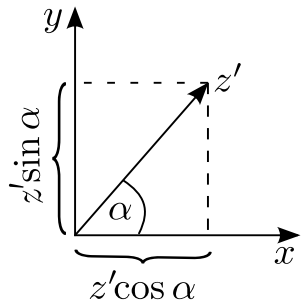
Exercise 4.2 (Cavalier perspective)



To get the point $p' = \begin{pmatrix} x' \\ y' \\ 0 \\ 1 \end{pmatrix}$ from the point $p = \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$ we must divide z in half and project it on the x/y-axis and must this add to the x/y value.

Projection: the z' in the picture equals -0.5z $\Rightarrow p' = \begin{pmatrix} x - 0.5cos(\alpha)z \\ y - 0.5cos(\alpha)z \\ 0 \\ 1 \end{pmatrix}$



$$p' = Mp \Longleftrightarrow \begin{pmatrix} x - 0.5cos(\alpha)z \\ y - 0.5cos(\alpha)z \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & q \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} ax + by + cz + d \\ ex + fy + gz + h \\ ix + jy + kz + l \\ mx + ny + oz + q \end{pmatrix}$$

$$\Rightarrow M = \begin{pmatrix} 1 & 0 & -0.5\cos(\alpha) & 0 \\ 0 & 1 & -0.5\cos(\alpha) & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

With $\alpha = 45°$ and $\cos(45°) = \sin(45°) = \frac{1}{\sqrt{2}}$ we get: $M = \begin{pmatrix} 1 & 0 & -\frac{1}{2\sqrt{2}} & 0 \\ 0 & 1 & -\frac{1}{2\sqrt{2}} & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$