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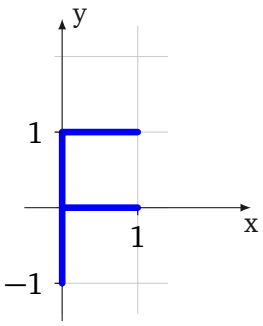
Problem sheet for chapter 8: Affine maps and homogeneous coordinates

Problem 1:

Consider the letter F and the two transforms **S** and **T** described below:



$$\mathbf{S} = \begin{pmatrix} \frac{1}{2} & 0 \\ 0 & 2 \end{pmatrix}$$

$\mathbf{T}$ = translation by 1 unit into x-direction

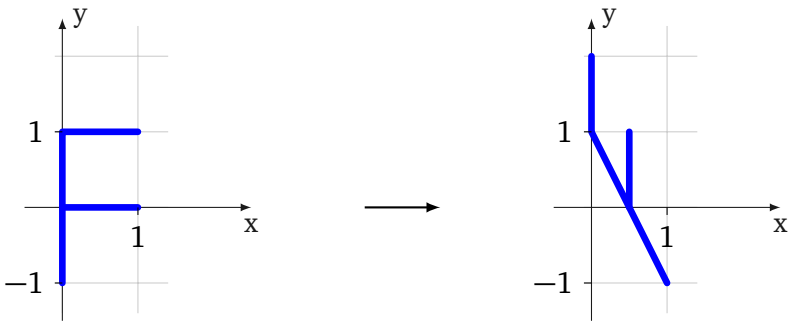
(a) Draw the letter F after the transform $\mathbf{S} \cdot \mathbf{T}$ has been applied to it.

(b) Draw the letter F after the transform $\mathbf{T} \cdot \mathbf{S}$ has been applied to it.

(c) Write down the 3×3-matrix representations of $\mathbf{S} \cdot \mathbf{T}$ and $\mathbf{T} \cdot \mathbf{S}$.

Problem 2:

Consider an affine map that transforms the left F to the right F:



(a) Is the map linear? Why or why not?

(b) Determine a 3×3 matrix representing this map in terms of homogeneous coordinates. Hint: Split the map into a linear part and a translation. What does the linear part do to the unit vectors $\vec{e}_x$ and $\vec{e}_y$?

Problem 3:

Construct a 3×3 matrix that implements a (generalized) rotation of 90° in $\mathbb{R}^2$ around the point $(2, 1)$ in terms of homogeneous coordinates. As a test apply your matrix to the points $(3, 1)$ and $(3, 2)$. Also, construct the 3×3 matrix implementing the inverse map.