

**Homework # 1 (new & improved!)***due: 2-25*

1. Let the four points

$$\underline{\mathbf{a}} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \quad \underline{\mathbf{b}} = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \quad \underline{\mathbf{c}} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \quad \underline{\mathbf{d}} = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}.$$

define a projective coordinate system. Write the point  $\underline{\mathbf{x}} = [2, 3, 4]^T$  in terms of  $\underline{\mathbf{a}}, \underline{\mathbf{b}}, \underline{\mathbf{c}}$ .

Some help (in case you run into this):

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

Then repeat with  $\underline{\mathbf{d}} = [1, -1, 1]^T$ .

2. consider the four collinear points

$$\underline{\mathbf{a}} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \quad \underline{\mathbf{b}} = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \quad \underline{\mathbf{c}} = \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}, \quad \underline{\mathbf{d}} = \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}.$$

Compute their cross ratio. Then replace  $\underline{\mathbf{d}}$  by  $\alpha \underline{\mathbf{d}}$ . What is the new cross ratio (as a function of  $\alpha$ )?

*No handwritten Homework please!*