Projective Geometry: Homogeneous Points

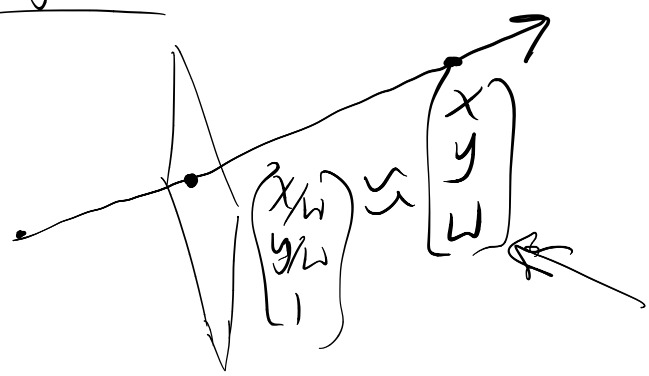
Recall: "math hack" $\begin{bmatrix} x \\ y \end{bmatrix} \to \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$ $\begin{bmatrix} x \\ y \\ w \end{bmatrix}$

Enables linear-plus-translation

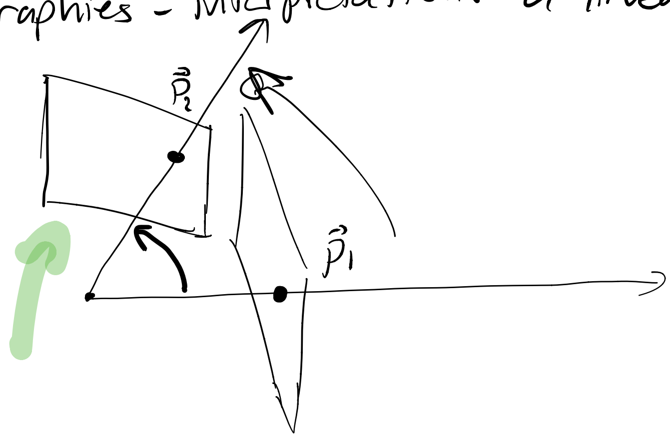
$\begin{bmatrix} x \\ y \\ w \end{bmatrix}$ 2D homogeneous representing 2D pt: $\begin{bmatrix} x/w \\ y/w \end{bmatrix}$

Formally, a 2D homogeneous pt is an object in $\mathbb{P}^2$ (projective space)
2D

A geometric interpretation: objects in $\mathbb{P}^2$ are the projection onto a plane of objects in $\mathbb{R}^3$.



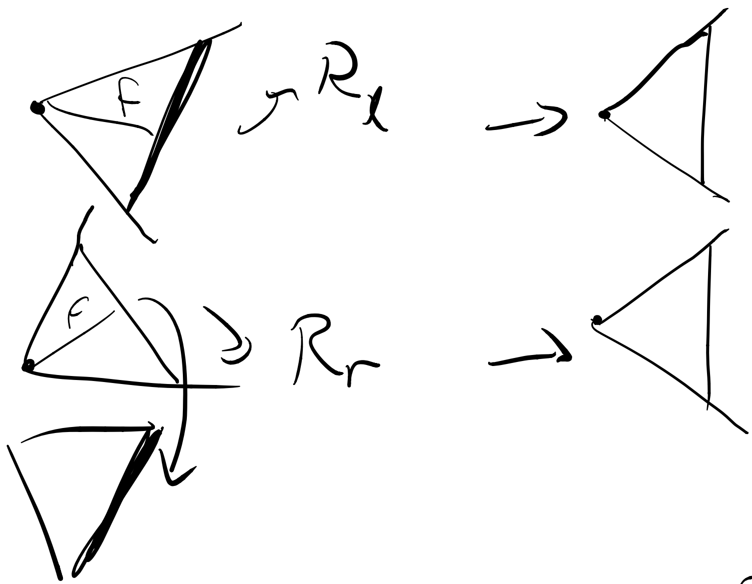
Homographies - interpretation: a linear transform on the $\mathbb{R}^3$ objects
e.g. image plane!



To project into a different (rotated) plane, apply a (3D) rotation.

Stereo Rectification

Have: Want:



$$\vec{P}_2 = R\,\vec{P}_1$$

$$X_{pixel} = K\, X_{cam}$$

$$q_{2_{pix}} = K_l R_{rl} K_r^{-1} \vec{q}_{1_{pix}}$$

$$[K R K^{-1}]_{3\times3} \text{ aka } H$$