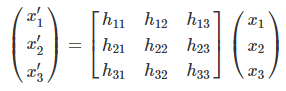
# EX 1

A: Homography computation

*A.1*

projective transformation is a linear transformation on homogeneous 3-vector represented by a **non-singular** 3x3 matrix.



Or in short,



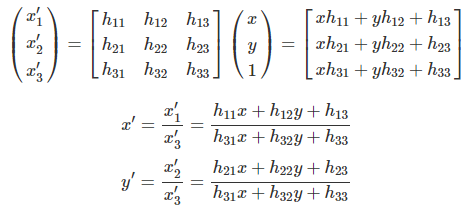
Both x and x′ are homogeneous coordinate so x can have a scaling factor derived from matrix H. As a result, we can divide H by and have this scalar position equal to 1 than.

Thus, we say that H is a **homogeneous matrix**. There’re **8** independent ratios among the **9** elements of H, and it follows that a projective transformation has **8 degrees of freedom (dof)**.

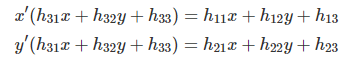
Get the conversion matrix is as follow:

Selecting a section of image corresponding to a planar section of the world. Let the inhomogeneous coordinate of a pair of matching points in the world and image place be (x,y) and (x′,y′) respectively.

The projective transformation can be written in inhomogeneous form as:



Each point correspondence (x,y) <-> (x′,y′) generates two equations for the elements of H as follow:



Notice that these are linear equations for elemnts in H. **4** point of correspondence lead to **8** of such linear equations in the entries of HH, which are sufficient to solve HH (since HH has 8 dof) up to an insignificant multiplicative factor.

The only restriction is that the 4 points must be in “general position”, which means that not 3 points are collinear.

*2 (In code)*

*3*

Naive Homography 0.0157 sec

[[-1.12313781e-03 -1.64757662e-04 9.99919585e-01]

[-1.05117244e-05 -1.05462483e-03 1.25622164e-02]

[-2.96940746e-07 -4.35706349e-08 -7.82907867e-04]]