Exercise 1.

$$X_1 = \begin{pmatrix} 4 \\ -2 \\ 2 \end{pmatrix} \xrightarrow{/2} \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix} \longrightarrow x_1 = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$$

Homogeneous

2D cartesian coordinate

$$X_2 = \begin{pmatrix} 3 \\ -2 \\ -1 \end{pmatrix} \xrightarrow{/-1} \begin{pmatrix} -3 \\ 2 \\ 1 \end{pmatrix} \rightarrow x_2 = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$$

$$X_3 = \begin{pmatrix} 4\lambda \\ -2\lambda \\ 2\lambda \end{pmatrix} \xrightarrow{/2\lambda} \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix} \rightarrow x_3 = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$$

X_4 means that no transformation / translation can be applied to X_4 as the last row has 0 which will lead to the same matrix after multiplication.

Exercise 4.

$$H = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{pmatrix} \quad X_1 = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \quad X_2 = \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$$

Y_1 & $Y_2 \sim HX_1$ & HX_2

$$Y_1 \sim \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{pmatrix}\begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \qquad \left.\begin{matrix} x & = 0 \\ x + y + z & = 0 \end{matrix}\right\} \rightarrow \begin{cases} x = 0 \\ y = t \\ z = -t \end{cases}$$

$$\longrightarrow \quad l_2 = \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$$

$$Y_2 \sim \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{pmatrix}\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$