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§§12.5: Lines and Planes

Find a vector equation for the line of intersection of the two planes in $\mathbb{R}^3$.

$$x + y = 1 \text{ and } x + z = 1$$

Make sure to show all your steps to (1) find ~~the~~ a point ~~of~~ in the intersection of the planes, and (2) find a vector which is parallel to both planes.

(1) $\begin{cases} x+y=1 \\ x+z=1 \end{cases} \Rightarrow \begin{cases} x=1-y \\ (1-y)+z=1 \end{cases} \Rightarrow \begin{array}{l} x=1-y \\ y=z \end{array}$

So e.g. $(0,1,1)$ is in the line of intersection.

(2) $\vec{n}_1 = \langle 1,1,0 \rangle$

$\vec{n}_2 = \langle 1,0,1 \rangle$

$\vec{v} = \vec{n}_1 \times \vec{n}_2$

$$\vec{v} = \langle 1,1,0 \rangle \times \langle 1,0,1 \rangle = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{vmatrix}$$

$$= \hat{\imath} \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix} - \hat{\jmath} \begin{vmatrix} 1 & 0 \\ 1 & 1 \end{vmatrix} + \hat{k} \begin{vmatrix} 1 & 1 \\ 1 & 0 \end{vmatrix}$$

$$= \hat{\imath} - \hat{\jmath} - \hat{k} = \langle 1,-1,-1 \rangle$$

So $\boxed{\ell(t) = \langle 0,1,1 \rangle + t\langle 1,-1,-1 \rangle}$