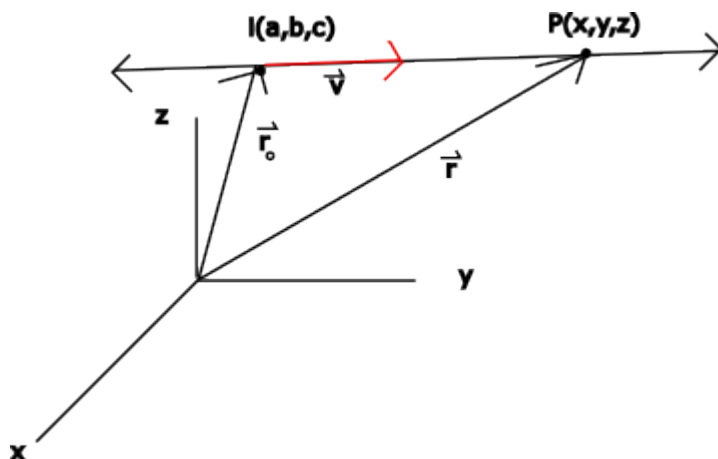


# 1 Equations of Lines and Planes



$$\vec{r} = \vec{r}_0 + t\vec{v}$$

$t$  is the parameter of the equation.

Reiterate:  $\vec{r} = \vec{r}_0 + t\vec{v}$

Let  $\vec{v} = \langle a, b, c \rangle$

then  $\langle x, y, z \rangle = \langle x_0, y_0, z_0 \rangle + t \langle a, b, c \rangle$

$\langle x, y, z \rangle = \langle x_0 + ta, y_0 + tb, z_0 + tc \rangle$

So the parametric equations for a line are as follows:

- $x = x_0 + ta$
- $y = y_0 + tb$
- $z = z_0 + tc$

When you solve for  $t$ , you get the symmetric equations.

$$t = \frac{x-x_0}{a} = \frac{y-y_0}{b} = \frac{z-z_0}{c}$$

If  $b = 0$ , then you get:

$$\frac{x-x_0}{a} = \frac{z-z_0}{c}, y = y_0$$

**incomplete do later**

Ex. Find where line L intersects plane  $5x - 2y + 4z = 18$

$L : x = -4t, y = 5 + t, z = 2 + 3t$

$$5(-4t) - 2(5 + t) + 4(2 + 3t) = 18 \quad (1)$$

$$-20t - 10 - 2t + 8 + 12t = 18 \quad (2)$$

$$-10t = 20 \quad (3)$$

$$t = -2 \quad (4)$$

1. Two planes are parallel if their normal vectors are parallel.
2. Two planes that are not parallel intersect along a line
3. The angle between intersecting planes is the angle between their normal vectors

Ex.: Consider planes  $x + y + z = 1$  and  $3x + y - 2z = 1$

a) Find the angle between the planes

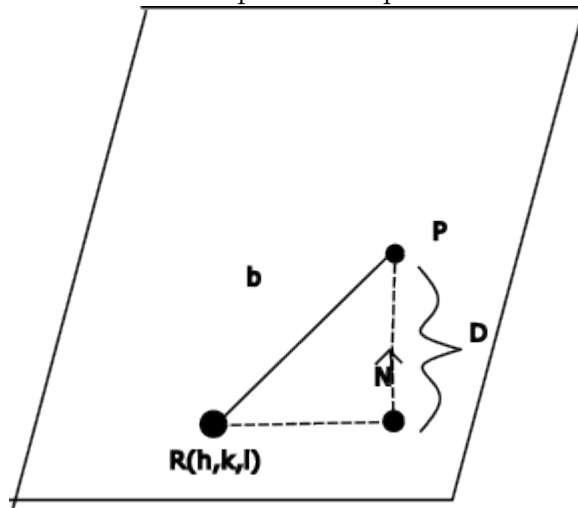
## 1.1 Continued

$$\vec{n}_1 = \langle 1, 1, 1 \rangle, \vec{n}_2 = \langle 3, 1, -2 \rangle \quad (1)$$

$$\vec{n}_1 \cdot \vec{n}_2 = |\vec{n}_1| |\vec{n}_2| \cos \theta \quad (2)$$

Use the equations of two planes to describe a line

Distance from a point to a plane



$$P_1(x_1, y_1, z_1)$$

$$ax + by + cz + d = 0$$

EX: Find the distance between the parallel planes

## 1.2 E

x: Find the distance between the lines  $L_1$  and  $L_2$

The distance between  $L_1$  and  $L_2$  is the same as the distance between the two parallel planes that contain these lines.

The normal vector  $\vec{n}$  for these two planes must be orthogonal to  $\vec{v}_1$  and  $\vec{v}_2$