# Multivariable Calculus
# Day 3
# Equations for lines and planes

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# Equations for lines and planes

# Equation for a line

A line is a collection of points that is parallel to a vector and goes through a

$$L = \left\{ \mathbf{r}(t) \,|\, \mathbf{r}(t) = \mathbf{r}_0 + t\mathbf{v}, t \in \right\},$$

where $r_0$ is the initial position and $\mathbf{v}$ is the direction. The equation for $\mathbf{r}(t)$ is called a **vector equation for a line** $L$.

# Equation for a line

Let $\mathbf{v} = \langle v_1, v_2, v_3 \rangle$ and $\mathbf{r}_0 = (x_0, y_0, z_0)$. The **parametric equations** of $L$ is the following system of equations

$$\begin{aligned} x &= x_0 + v_1 t\,, \\ y &= y_0 + v_2 t\,, \\ z &= z_0 + v_3 t\,. \end{aligned}$$

This leads to the **symmetric equations** of $L$

$$\frac{x - x_0}{v_1} = \frac{y - y_0}{v_2} = \frac{z - z_0}{v_3}\,.$$

# Equation for plane

A hyperplane is a collection of points that is perpendicular to one specific direction

$$P = \{\mathbf{r} \,|\, \mathbf{n} \cdot (\mathbf{r} - \mathbf{r}_0) = 0\}\,.$$

**n** is the perpendicular vector to the plane called the normal vector.