Lesson 7. Equations of Planes in 3D

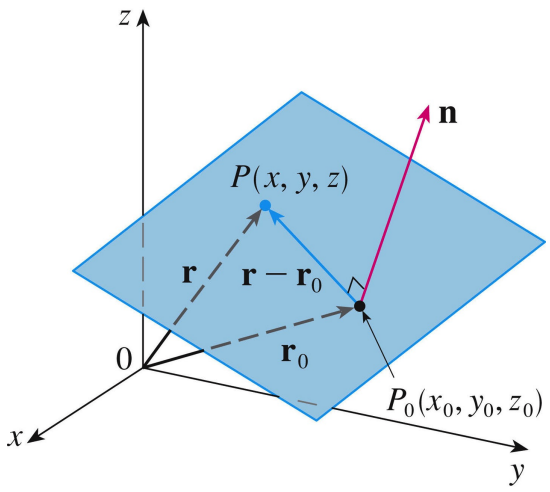
1 Today...

- Different ways of writing equations for planes in 3D

2 Vector and scalar equations

- A **plane** is determined by
  - a point $P_0(x_0, y_0, z_0)$ on the plane and
  - a **normal vector** $\vec{n}$ orthogonal to the plane
- Let $\vec{r}_0$ be the position vector of P_0; that is, $\vec{r}_0 =$
- Let $\vec{r}$ be the position vector of some point on the plane, say $\vec{r} = \langle x, y, z \rangle$

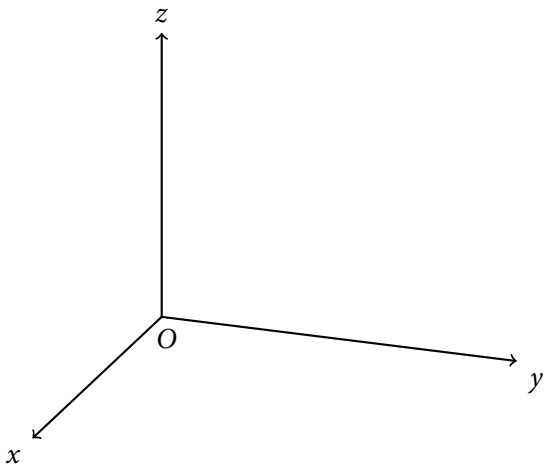
$\Rightarrow$ $\vec{r} - \vec{r}_0$ is a vector in the plane, and must be orthogonal to the normal vector $\vec{n}$



- The **vector equation** of the plane is
- Let $\vec{n} = \langle a, b, c \rangle$
- Expanding the vector equation, we obtain
- The **scalar equation** of the plane is

Example 1.

a. Find an equation of the plane through the point $(-1, 4, 2)$ with normal vector $\vec{n} = \langle 4, 3, 2 \rangle$.
b. Find where the plane intercepts the x-, y- and z-axes. Sketch the plane in the first orthant.



Example 2. Find an equation of the plane that passes through the point $(1, 2, 3)$ and is perpendicular to the line $x = 3t, y = 1 + t, z = 2 - t$.