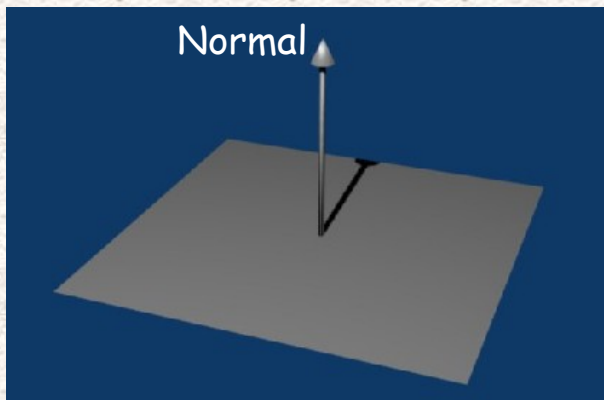


6.5 The Cartesian Equation of a Plane

The normal is a nonzero vector perpendicular to all vectors in the plane.



The Cartesian (or scalar) equation of a plane in \mathbb{R}^3 is of the form

$$Ax+By+Cz+D=0$$

with normal $\vec{n} = (A, B, C)$.

Ex. 1 Find the Cartesian equation of a plane with a normal of $(2, -3, 4)$ and a point $A(1, 2, 3)$.

Ex.2 Given three noncollinear points $A(2,3,4)$, $B(6,5,4)$ and $C(-2,4,-1)$.

a) Find two direction vectors

b) Find the normal to the plane

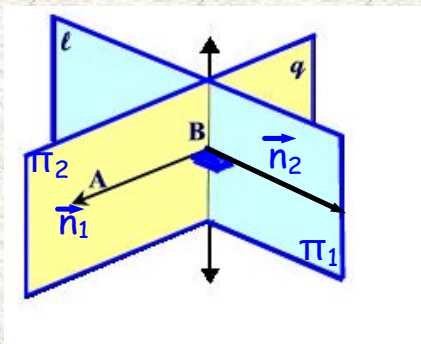
c) Determine the Cartesian equation of the plane

Note: To determine an equation for a plane you need two nonzero, noncollinear vectors and a point on the plane. If you are given the vector or parametric equations then you have all you need.

Ex. 3 Determine the vector and parametric equations of the plane given the Cartesian equation $x-3y+5z-1=0$.

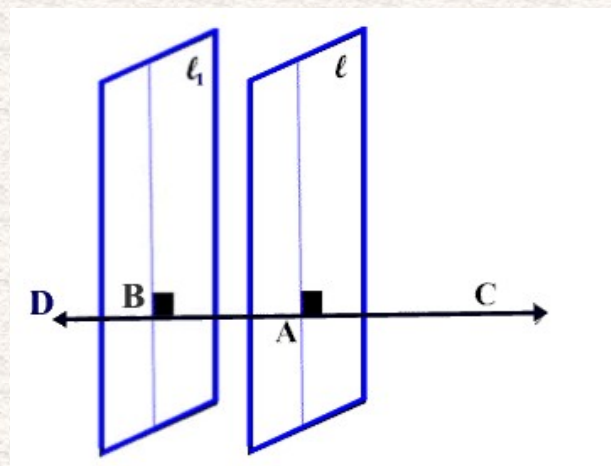
Perpendicular Planes have perpendicular normals.

$$\vec{n}_1 \cdot \vec{n}_2 = 0$$



Parallel Planes have parallel normals.

$$\vec{n}_1 = k\vec{n}_2, \text{ for nonzero real numbers } k.$$

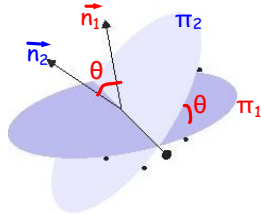


Ex4 a) What is the value of k that makes $4x+ky-2z+1=0$ and $2x+4y-z+4=0$ parallel?

b) What is the value of k that makes these two planes perpendicular?

c) Can these planes ever be coincident? Explain.

Angle between Intersecting planes



Use the normals to find the angle between the planes

$$\cos \theta = \frac{\vec{n}_1 \cdot \vec{n}_2}{\|\vec{n}_1\| \|\vec{n}_2\|}$$

Ex.5 Determine the angle between the two planes $x+2y-3z-4=0$ and $x+2y-1=0$



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