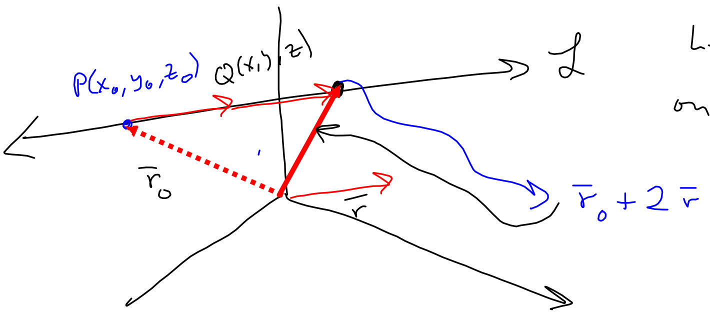
See videos for some §12.5 exercises!



Let (x, y, z) be a point on the line.

In general, the line is given in vector form as $\bar{r}_0 + t\bar{r}$, $\forall t \in \mathbb{R}$

Let $(x_0, y_0, z_0) = (1, 2, 3) \rightsquigarrow \bar{r}_0 = \langle 1, 2, 3 \rangle$

$\bar{r} = \langle -3, 2, -7 \rangle$

$$\bar{r}_0 + t\bar{r} = \langle 1, 2, 3 \rangle + t \langle -3, 2, -7 \rangle$$

$$= \langle -3t + 1, 2t + 2, -7t + 3 \rangle$$

Parametric Form of the line

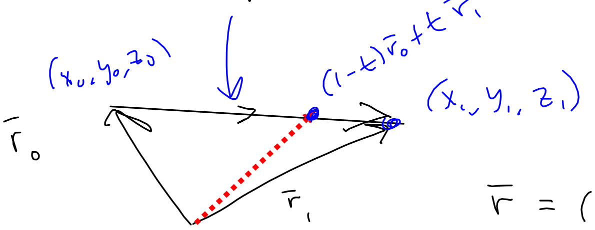
$$x = -3t + 1, \quad y = 2t + 2, \quad z = -7t + 3$$

Solve for t:

$$\frac{x-1}{-3} = \frac{y-2}{2} = \frac{z-3}{-7}$$

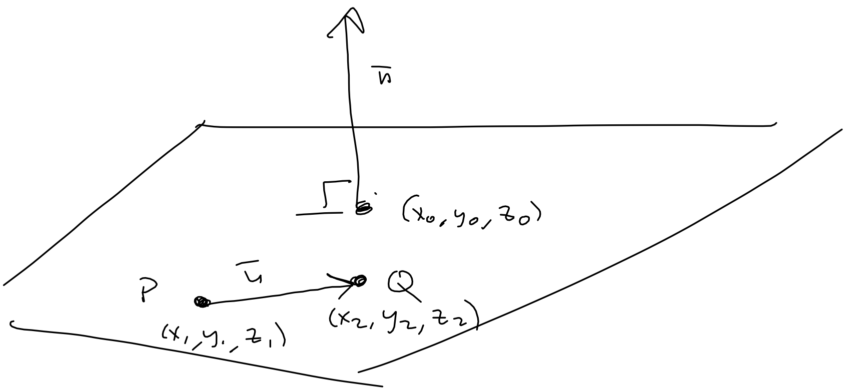
Symmetric Eq'ns.
Not tested.
Don't come up, much AFAIK.

Line Segment



$$\bar{r} = (1-t)\bar{r}_0 + t\bar{r}_1$$

A plane



Let $\bar{v}$ be any vector "in" the plane (parallel to the plane.)

Then $\bar{n}$ & $\bar{u}$ are $\perp$.

This means $\bar{n} \cdot \bar{u} = 0$

In particular, let (x, y, z) be any point in the plane. Then $\bar{v} = \langle x - x_0, y - y_0, z - z_0 \rangle$ is a vector in the plane & $\therefore$ $\perp$ to $\bar{n}$ = the normal vector $\bar{n}$. $\bar{n} = \langle a, b, c \rangle \implies$

$$\bar{n} \cdot \bar{v} = 0 = a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$$

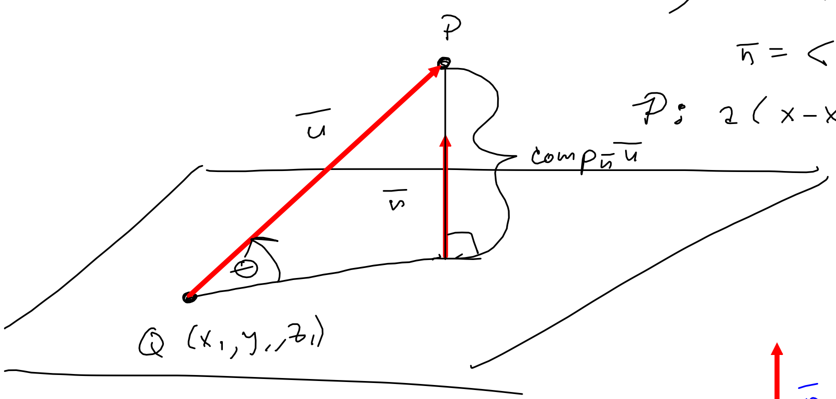
$$\langle a, b, c \rangle \cdot \langle x - x_0, y - y_0, z - z_0 \rangle$$

Distance from a point to a plane, $\mathcal{P}$.

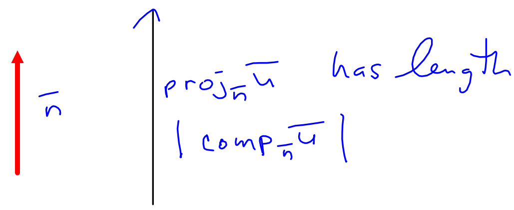
$P(x_0, y_0, z_0)$, $Q(x_1, y_1, z_1) \in \mathcal{P}$

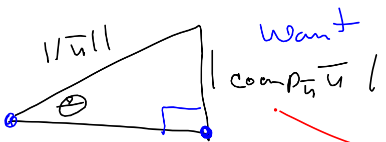
$\bar{n} = \langle a, b, c \rangle$

$\mathcal{P}$: $a(x - x_1) + b(y - y_1) + c(z - z_1) = 0$



Distance will be $\text{comp}_{\bar{n}}\bar{u}$





$\sin\theta = \dfrac{|\text{comp}_{\bar{n}}\bar{u}|}{\|\bar{u}\|}$

$\cancel{|\text{comp}_{\bar{n}}\bar{u}| = \|\bar{u}\| \sin\theta} =$

Teacher so wanted to use cross-product here!

$$|\text{comp}_{\bar{n}}\bar{u}| = \left| \frac{\bar{u} \cdot \bar{n}}{\|\bar{n}\|} \right| = \frac{|a(x_0 - x_1) + b(y_0 - y_1) + c(z_0 - z_1)|}{\sqrt{a^2 + b^2 + c^2}}$$

Distance between 2 planes? Just find ANY point on the 2nd plane, and then do point-to-a-plane, as above, only with fewer fits and starts than your dumb teacher.

$$\langle 1,2,3\rangle \; 1,2$$

$$\times \quad \langle -1,-3,2\rangle \; -1,-3$$

$$\langle 13,-5,-1\rangle = \bar{a} \times \bar{b}$$

The reason I was so dead set on doing cross product in the derivation of distance from point to plane was the homework, where there was a problem requiring you (me) to BUILD a normal vector to the plane, using 2 vectors IN the plane. This gave us an expression for the normal vector - and thus the component in its DIRECTION - that involved a cross product.

sigh

It was having that 12.4 #44 exercise stuck in my head from last Friday's video-production session.