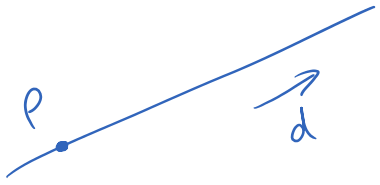
# Review for Test 1:

Wednesday, September 28, 2022 12:45 PM

## Section 1.3: Lines and Planes

two ways to represent a line in $\mathbb{R}^3$:

(1) point plus a direction vector




any point on line X has

vector form $\vec{X} = \vec{p} + t\vec{d}$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix} + t\begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

parametric form

$$\begin{cases} x = p_1 + td_1 \\ y = p_2 + td_2 \\ z = p_3 + td_3 \end{cases}$$

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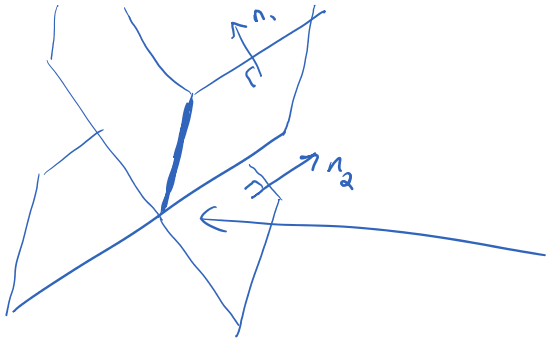
(2)




line = intersection of two planes

general form

$$\begin{cases} a_1x + b_1y + c_1z = d_1 \\ a_2x + b_2y + c_2z = d_2 \end{cases}$$

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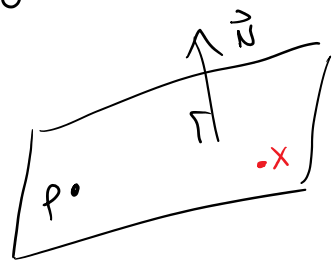
two ways to represent a plane in $\mathbb{R}^3$:

(1)




a point and a normal $\vec{N}$

general form

$ax + by + cz = d$

where $\vec{N} = \begin{bmatrix} a \\ b \\ c \end{bmatrix}$

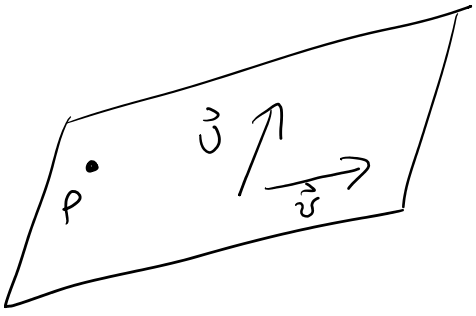
plug in point P to find d

normal form:

$\vec{PX} \cdot \vec{N} = 0$

$\begin{bmatrix} x - p_1 \\ y - p_2 \\ z - p_3 \end{bmatrix} \cdot \begin{bmatrix} a \\ b \\ c \end{bmatrix} = 0$

(2)




a point P and two vector $\vec{u}$ and $\vec{v}$ ($\vec{u}$ is not // with $\vec{v}$)

$\vec{X} = \vec{P} + s\vec{u} + t\vec{v}$

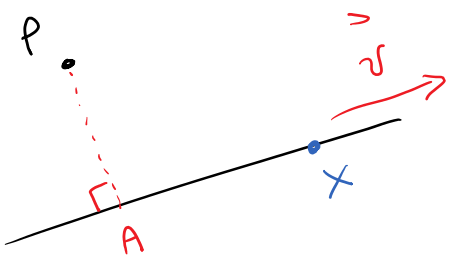
$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix} + s\begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} + t\begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$

vector form

$\begin{cases} x = p_1 + su_1 + tv_1 \\ \text{etc} \end{cases}$

parametric form

# distance from point to line / plane

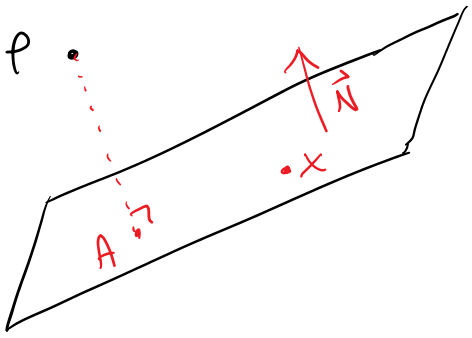



pick some other point on line
X

know $\vec{PX}$ and $\vec{v}$

$\vec{AX} = \text{proj}_{\vec{v}}(\vec{PX})$

vector subtraction gives $\vec{PA}$




$\vec{PA} = \text{proj}_{\vec{N}}(\vec{PX})$