## coplanar lines condition:

$$\begin{vmatrix} x_2-x_1 & y_2-y_1 & z_2-z_1 \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} = 0$$

$$\left.\begin{aligned} \frac{x-x_1}{a_1} &= \frac{y-y_1}{b_1} = \frac{z-z_1}{c_1} \\ \frac{x-x_2}{a_2} &= \frac{y-y_2}{b_2} = \frac{z-z_2}{c_2} \end{aligned}\right\} \text{2 lines}$$

$\longrightarrow$ coplanarity condition.

## Angle between 2 lines in Vector form.

$\bar{a}$ and $\bar{b}$ are two vectors.

angle between them

$$\boxed{\theta = \cos^{-1} \frac{\bar{a}\cdot\bar{b}}{|\bar{a}|\,|\bar{b}|}} \star$$

$\bar{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$

$\bar{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$

$|\bar{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2}$

$|\bar{b}| = \sqrt{b_1^2 + b_2^2 + b_3^2}$.

$\bar{a}\cdot\bar{b} = a_1b_1 + a_2b_2 + a_3b_3$

## → Cartesian form.

$$\frac{x-x_1}{a_1} = \frac{y-y_1}{b_1} = \frac{z-z_1}{c_1}$$

$$\frac{x-x_2}{a_2} = \frac{y-y_2}{b_2} = \frac{z-z_2}{c_2}$$

$$\cos\theta = \left| \frac{a_1b_1 + b_1b_2 + a_1c_2}{\sqrt{a_1^2+b_1^2+c_1^2}\cdot\sqrt{a_2^2+b_2^2+c_2^2}} \right|$$

$\theta$ is angle

## ⇒ Angle Between Plane And Line

$$\frac{x-x_1}{a_1} = \frac{y-y_1}{b_1} = \frac{z-z_1}{c_1} \qquad a_2x + b_2y + c_2z + d = 0.$$

$$\sin\theta = \left| \frac{a_1a_2 + b_1b_2 + c_1c_2}{\sqrt{a_1^2+b_1^2+c_1^2}\cdot\sqrt{a_2^2+b_2^2+c_2^2}} \right|$$

$\theta$ → angle.

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Distance between two parallel ~~lines~~ planes

$ax + by + cz + d_1 = 0$

$ax + by + cz + d_2 = 0$

is $\left| \dfrac{d_2 - d_1}{\sqrt{a^2+b^2+c^2}} \right|$

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