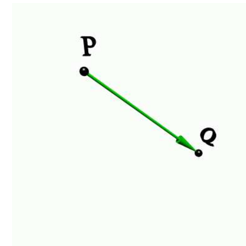
DISTANCE POINT-POINT (3D). If $P$ and $Q$ are two points, then

$$d(P,Q) = |\vec{PQ}|$$

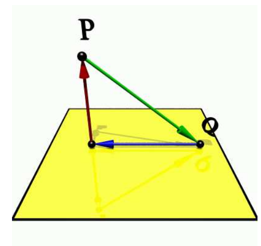
is the distance between $P$ and $Q$.




DISTANCE POINT-PLANE (3D). If $P$ is a point in space and $\Sigma : \vec{n} \cdot \vec{x} = d$ is a plane containing a point $Q$, then

$$d(P,\Sigma) = |(\vec{PQ}) \cdot \vec{n}|/|\vec{n}|$$

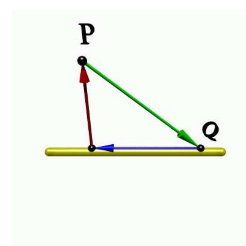
is the distance between $P$ and the plane.




DISTANCE POINT-LINE (3D). If $P$ is a point in space and $L$ is the line $\vec{r}(t) = Q + t\vec{u}$, then

$$d(P,L) = |(\vec{PQ}) \times \vec{u}|/|\vec{u}|$$

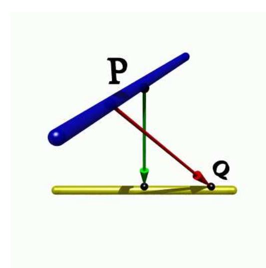
is the distance between $P$ and the line $L$.



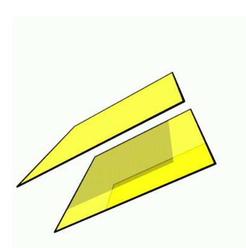

DISTANCE LINE-LINE (3D). $L$ is the line $\vec{r}(t) = Q + t\vec{u}$ and $M$ is the line $\vec{s}(t) = P + t\vec{v}$, then

$$d(L,M) = |(\vec{PQ}) \cdot (\vec{u} \times \vec{v})|/|\vec{u} \times \vec{v}|$$

is the distance between the two lines $L$ and $M$.



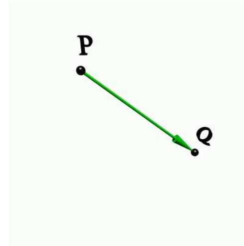

DISTANCE PLANE-PLANE (3D). If $\vec{n} \cdot \vec{x} = d$ and $\vec{n} \cdot \vec{x} = e$ are two parallel planes, then their distance is $(e-d)/|\vec{n}|$. Nonparallel planes have distance 0.



## EXAMPLES

DISTANCE POINT-POINT (3D). $P = (-5, 2, 4)$ and $Q = (-2, 2, 0)$ are two points, then

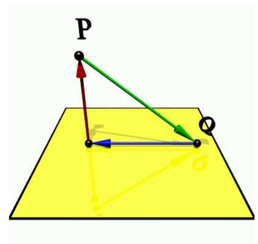
$$d(P, Q) = |\vec{PQ}| = \sqrt{(-5+2)^2 + (2-2)^2 + (0-4)^2} = 5$$




DISTANCE POINT-PLANE (3D). $P = (7, 1, 4)$ is a point and $\Sigma : 2x+4y+5z = 9$ is a plane which contains the point $Q = (0, 1, 1)$. Then

$$d(P, \Sigma) = |(7, 0, 3) \cdot (2, 4, 5)|/|\sqrt{45}| = 29/\sqrt{45}$$

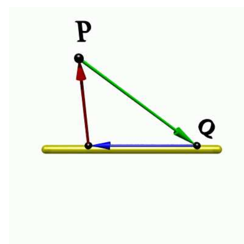
is the distance between $P$ and $\Sigma$.




DISTANCE POINT-LINE (3D). $P = (2, 3, 1)$ is a point in space and $L$ is the line $\vec{r}(t) = (1, 1, 2) + t(5, 0, 1)$. Then

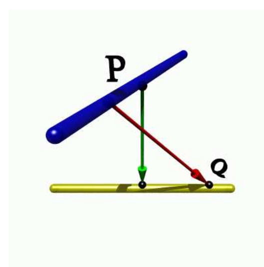
$$d(P, L) = |(1, 2, -1) \times (5, 0, 1)|/\sqrt{26} = |(2, -6, -10)|/\sqrt{26} = \sqrt{140}/\sqrt{26}$$

is the distance between $P$ and $L$.




DISTANCE LINE-LINE (3D). $L$ is the line $\vec{r}(t) = (2, 1, 4) + t(-1, 1, 0)$ and $M$ is the line $\vec{s}(t) = (-1, 0, 2) + t(5, 1, 2)$. The cross product of $(-1, 1, 0)$ and $(5, 1, 2)$ is $(2, 2, -6)$. The distance between these two lines is

$$d(L, M) = |(3, 1, 2) \cdot (2, 2, -6)|/\sqrt{44} = 4/\sqrt{44} \,.$$




DISTANCE PLANE-PLANE (3D). $5x + 4y + 3z = 8$ and $5x + 4y + 3z = 1$ are two parallel planes. Their distance is $7/\sqrt{50}$.