

Source: 1. Ray Tracing Essentials, Part-1 to 7  
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2. 3D Computer Graphics Primer: Ray-Tracing as an Example

From <<https://www.scratchapixel.com/lessons/3d-basic-rendering/introduction-to-ray-tracing/implementing-the-raytracing-algorithm.html>>

## Ray - Plane Intersection :-

Let a ray,

origin  $O = [O_x, O_y, O_z]$

direction  $R = [R_x, R_y, R_z]$

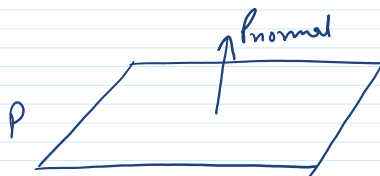
$$\boxed{P = O + Rt} \quad \text{--- ①}$$

Plane

$$P: \boxed{Ax + By + Cz + D = 0} \quad \text{--- ②}$$

$P_{\text{normal}}$  :- normal of the plane  
 $= [A \ B \ C]$   
 $A^2 + B^2 + C^2 = 1$

$D$  :- distance from origin



Substituting  $P_x, P_y, P_z$  from equation ① into ②

$$A(P_x) + B(P_y) + C(P_z) + D = 0$$

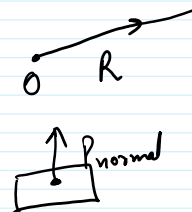
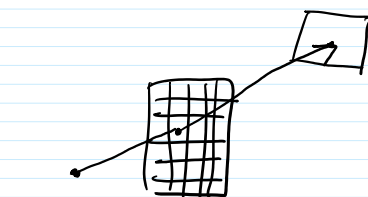
$$A(O_x + R_x t) + B(O_y + R_y t) + C(O_z + R_z t) + D = 0$$

solving for  $t$ ,

$$AO_x + AR_x t + BO_y + BR_y t + CO_z + CR_z t + D = 0$$

$$t = - \frac{AO_x + BO_y + CO_z + D}{AR_x + BR_y + CR_z}$$

$$= - \frac{P_{\text{normal}} \cdot O + D}{P_{\text{normal}} \cdot R}$$

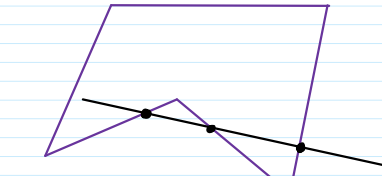


where if  $P_{\text{normal}} \cdot R \neq 0$  the ray is parallel

to the plane:  
 $P_{\text{normal}} \cdot R > 0$  normal is pointing away from the ray

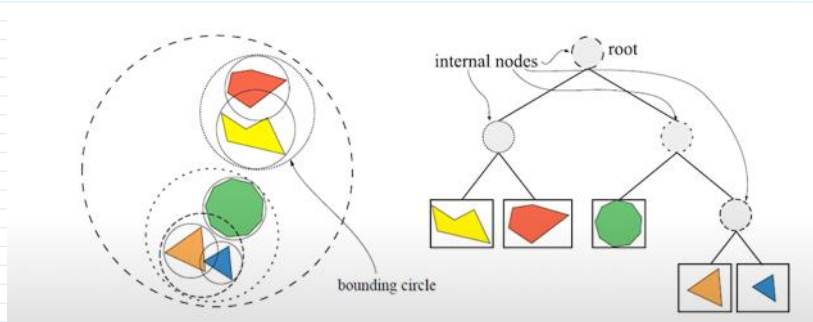
## Polygon Interaction :-

containment Test :-



If the number of intersections are odd the point is inside.

## Bounding Volume Hierarchies :- (BVH)



Tracing a ray is  $O(\log N)$

