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

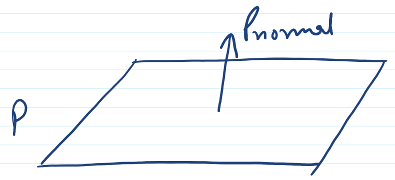
$$P : \boxed{Ax + By + Cz + D = 0} \quad \text{——} \; (2)$$

P_{normal} :- normal of the plane

$= [A \;\; B \;\; C]$

$A^2 + B^2 + C^2 = 1$

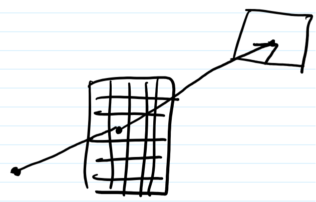
D :- distance from origin



Substituting P_x, P_y, P_z from equation (1) into (2)

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

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

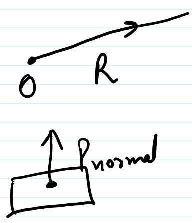


solving for t,

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

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

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

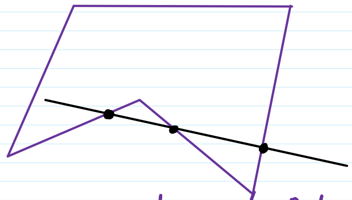


Where if $P_{normal} \cdot R = 0$ the ray is parallel to the plane.

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

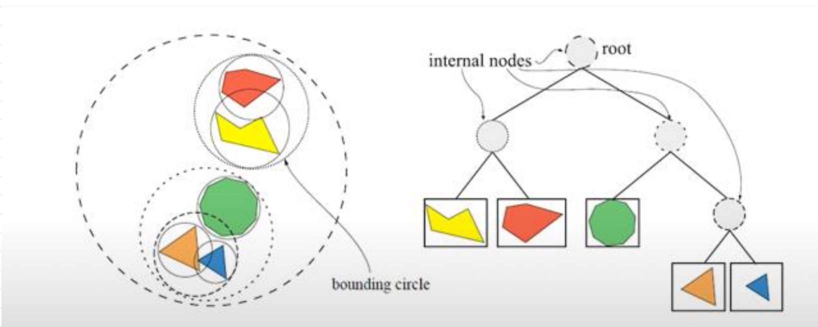
Polygon Intersection :-

Containment Test :-



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

Bounding Volume Hierarchies :- (BVH)



Tracing a ray is O(log N)