→ Have seen that Bounding spheres and Bounding ①
Rectangles are most common,

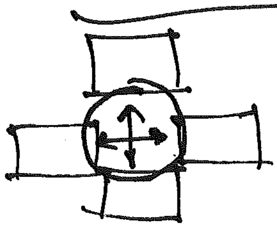
? How to mix and match ?

→ Consider projections of B.S & B.R on
primary planes

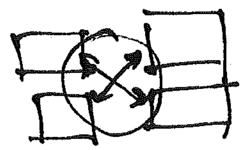
{ unlike sweep and prune which were projections onto the axis }

→ given pairwise comparison 9 cases occur

Circle (C, R) Rectangle CR



or



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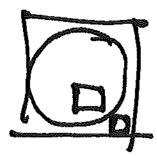

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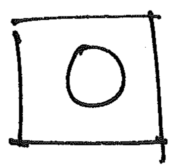


Algos:

→ Translate origin to C ~~C to origin~~ { R.H. Coordinate system }

→ compute Rmax = Rmax − C ; Rmin = Rmin − C

IF (Rmax.x < 0) R to left of circle center

THEN IF (Rmax.y < 0) lower left

~~THEN~~ ELSE IF (Rmax.y > 0) upper left

~~ELSE To the west~~ ②

⋮

→ Return condition ($Rmax.x^2 + Rmax.y^2 < Rad^2$)

ELSE To the WEST

→ Return $|Rmax.x| < Rad$ |

ELSE IF ($R.min.x > 0$) to the right

{ check for lower
or upper

→ Return ($Rmin.x^2 + Rmin.y^2 < Rad^2$)

→ Return ($Rmin.x < Rad$)

ELSE

check for south

check for north.

ELSE

R contains circle point.

} corollary: what is the general way of finding intersection b/n a box & sphere? }

- Efficient Bounding Spheres

→ Given "N" points in space find bounding

→ Algos $O(N)$

↳ Start to find max XYZ
min XYZ

→ one pair amongst these will give greatest distance

→ fix as dia,

→ $r = dia/2$, center $= \frac{max - min}{2}$

Alternate
- why not use Euclidean distance?

↳ Iterate thro' point

→ for given point

IF! $\left(x_c^2 + y_c^2 + z_c^2 < radius^2 \right)$

$\bar{X}_c = center - x$

→ update sphere with new point and radius

→ Worst case (Orthogonal Box of points)

Intersecting lines in 3 space

$$L_1(t) = P_1 + V_1(t) \quad \& \quad L_2(s) = P_2 + V_2(s)$$

parameters   points on line   direction vector

Intersection occurs when

$$P_1 + V_1(t) = P_2 + V_2(s)$$

or $\quad (V_1 \times V_2)t = (P_2 - P_1) \times V_2$

{ subtract P_1 & $\div$ by V_2

do a dot multiplication by $(V_1 \times V_2)$ & $\div$ by $|V_1 \times V_2|^2$

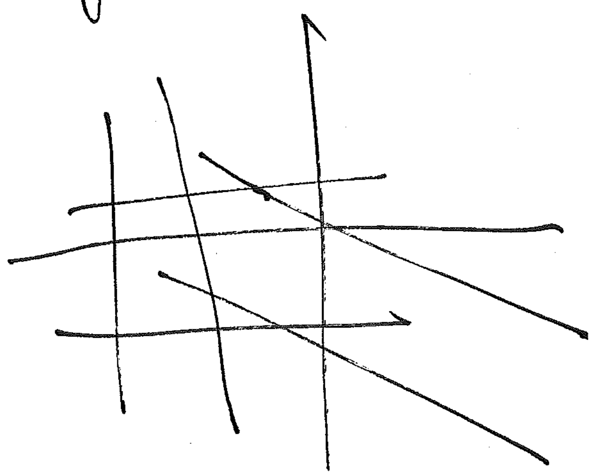
$$t = \frac{\operatorname{Det}\{(P_2 - P_1),\ V_2,\ V_1 \times V_2\}}{|V_1 \times V_2|^2}$$

if lines are $\|^{el}$, denom $V_1 \times V_2 = 0$

Line - Box Intersections

→ Assume it to be an OBB.

↳ consider the 2D case, a line (ray) can intersect a box in 3 planes



first common sense
→ i.e. if any component (x or y) = 0, for ray then no intersection in that direction

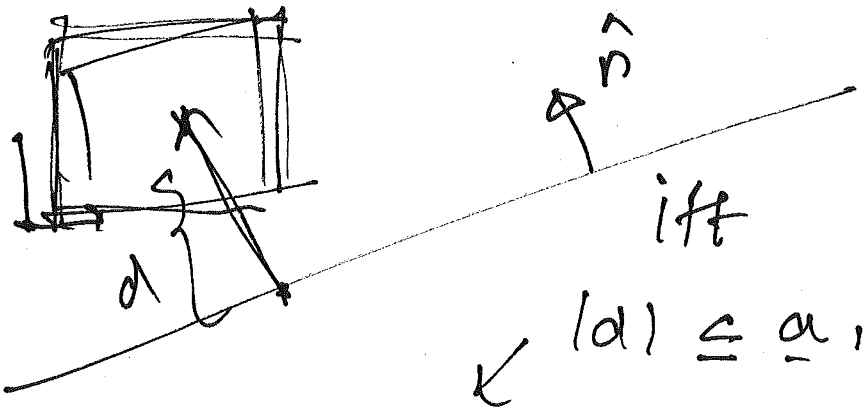
↳ for each axis

$$t_1 = (x_{min} - x_0) / x_d.$$

$$t_2 = (x_{max} - x_0) / x_d.$$

repeat for y & z.

Box Plane Intersection



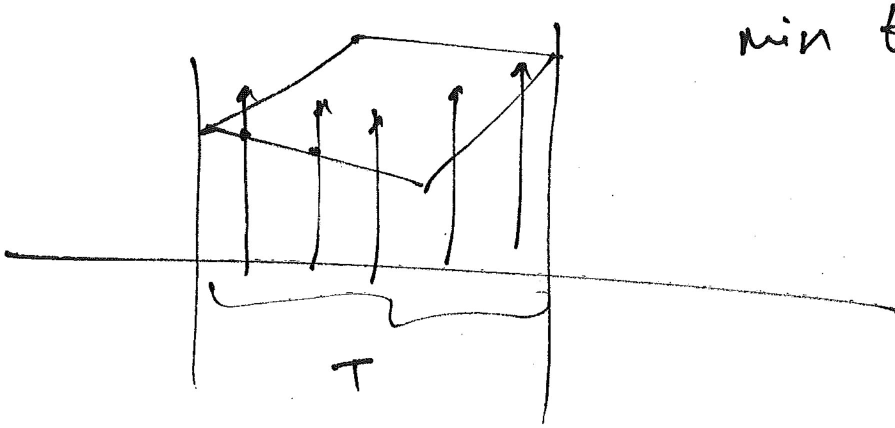
Intersection is returned true iff

$$|d| \le a_1 |n \cdot A^1| + a_2 |n \cdot A^2| + a_3 |n \cdot A^3|$$

perp dist

$A^1\ A^2\ A^3$ are the local axis

$a_1\ a_2\ a_3$ are dimensions of the box in those directions.



min t value.