Basic 3D Collision

Knox Game Design

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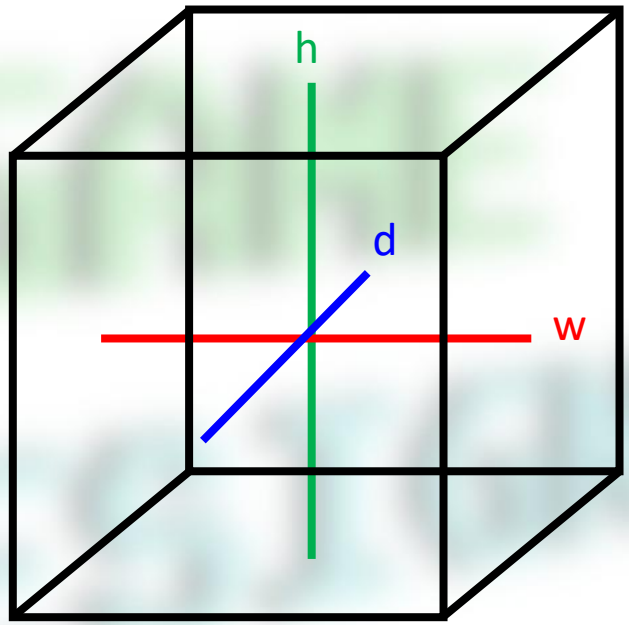
Types of collisions

- Cubes (rectangular solids)
- Spheres

Cube (rectangular solid)

- Center Point
  - x, y, z
- Width
  - w
- Height
  - h
- Depth
  - d



Cube (rectangular solid)

- NOT (when does it not collide)
- Assuming not rotated
- Does not collide conditions
  - To the right
  - To the left
  - Above
  - Below
  - In front (positive Z into the screen, like driving game)
  - Behind

Cube (rectangular solid)

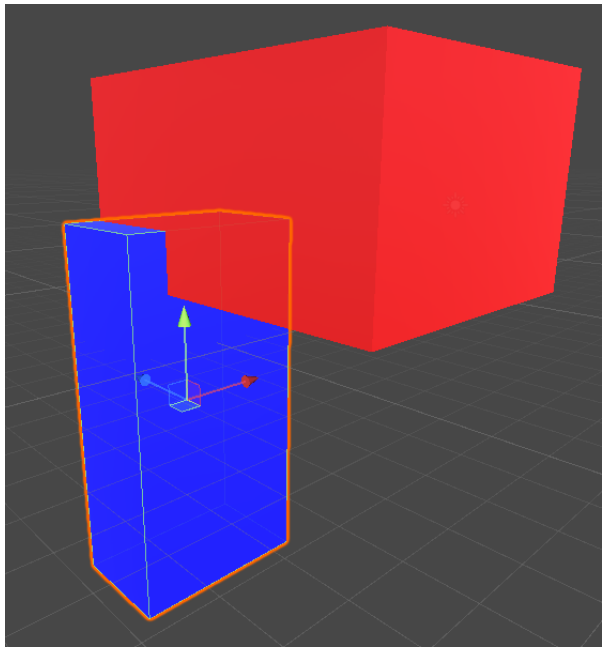
- To the right
  - r1.x - (r1.w / 2) > r2.x + (r2.w / 2)
- To the left
  - r1.x + (r1.w / 2) < r2.x - (r2.w / 2)
- Above
  - r1.y - (r1.h / 2) > r2.y + (r2.h / 2)
- Below
  - r1.y + (r1.h / 2) < r2.y - (r2.h / 2)
- In front
  - r1.z - (r1.d / 2) > r2.z + (r2.d / 2)
- Behind
  - r1.z + (r1.d / 2) < r2.z - (r2.d / 2)

Cube (rectangular solid) Examples

- Cube 1
  - x = -8
  - y = 4
  - z = -1
  - w = 7
  - h = 5
  - d = 9
- Cube 2
  - x = -10
  - y = -2
  - z = 2
  - w = 5
  - h = 10
  - d = 3

Right: -11.5 > -7.5 : false
Left: -4.5 < -12.5 : false
Above: 1.5 > 3.0 : false
Below: 6.5 < -7.0 : false
In Front: -5.5 > 3.5 : false
Behind: 3.5 < 0.5 : false

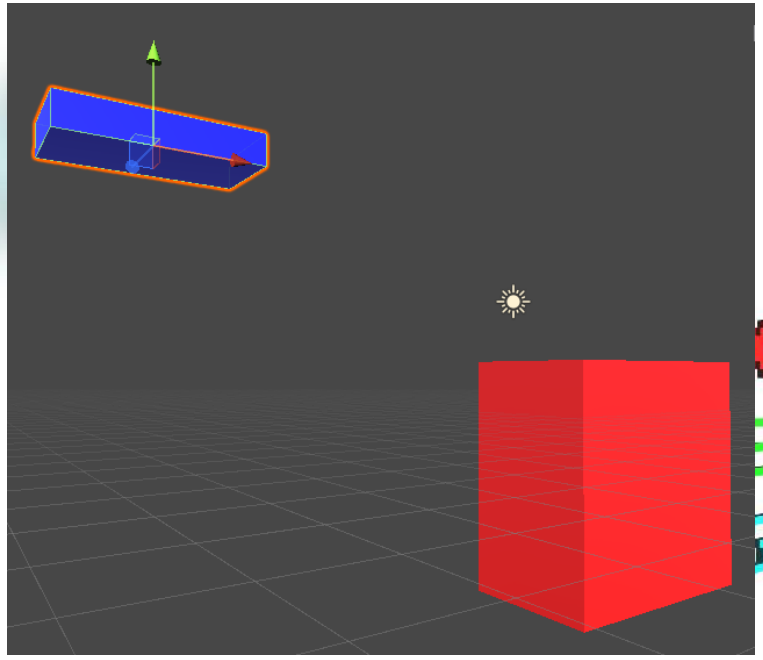
All false = cubes collide



- Cube 1
  - x = 5
  - y = -2
  - z = 1
  - w = 7
  - h = 7
  - d = 4
- Cube 2
  - x = -7
  - y = 8
  - z = 8
  - w = 6
  - h = 1
  - d = 3

Right: 1.5 > -4.0 : true
Left: 8.5 < -10.0 : false
Above: -5.5 > 8.5 : false
Below: 1.5 < 7.5 : true
In Front: -1.0 > 9.5 : false
Behind: 3.0 < 6.5 : true

Not All false = cubes don't collide



Sphere

- Center Point
  - x, y, z
- Radius
  - r

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Sphere

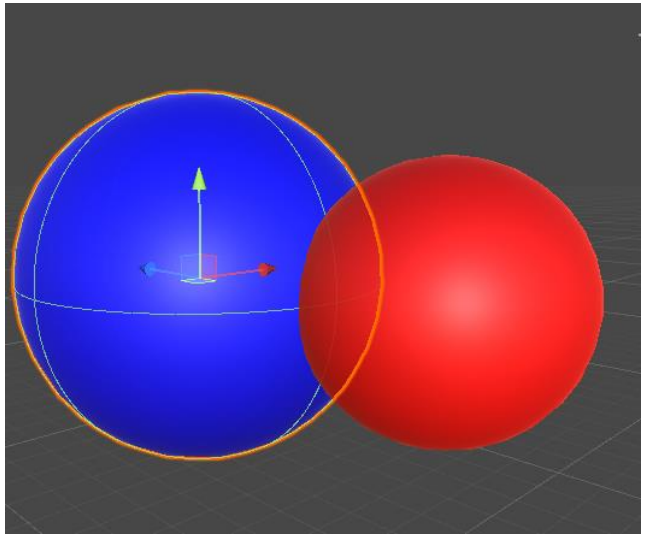
- Collision when
- Distance between two center points is less than sum of two radius values
- $d = \sqrt{(c1.x - c2.x)^2 + (c1.y - c2.y)^2 + (c1.z - c2.z)^2}$
- IF **d < c1.r + c2.r** THEN collided

Sphere Examples

- Sphere 1
  - x = 3
  - y = 5
  - z = -1
  - r = 2
- Sphere 2
  - x = 2
  - y = 5
  - z = 3
  - r = 3

$d = ((3 - 2)^2 + (5 - 5)^2 + (-1 - 3)^2)^{0.5}$
$d = (1 + 0 + 16)^{0.5}$
$d = (17)^{0.5}$
$d = 4.12$

$4.12 < 2 + 3$
$4.12 < 5$ (spheres collide)



- Sphere 1
  - x = 5
  - y = -1
  - z = -2
  - r = 2
- Sphere 2
  - x = -7
  - y = 10
  - z = -4
  - r = 7

$d = ((5 - (-7))^2 + ((-1) - 10)^2 + ((-2) - (-4))^2)^{0.5}$
$d = (144 + 121 + 4)^{0.5}$
$d = (269)^{0.5}$
$d = 16.40$

$16.40 > 2 + 7$
$16.40 > 9$ (spheres don't collide)