MULTIMEDIA & COMPUTER GRAPHICS

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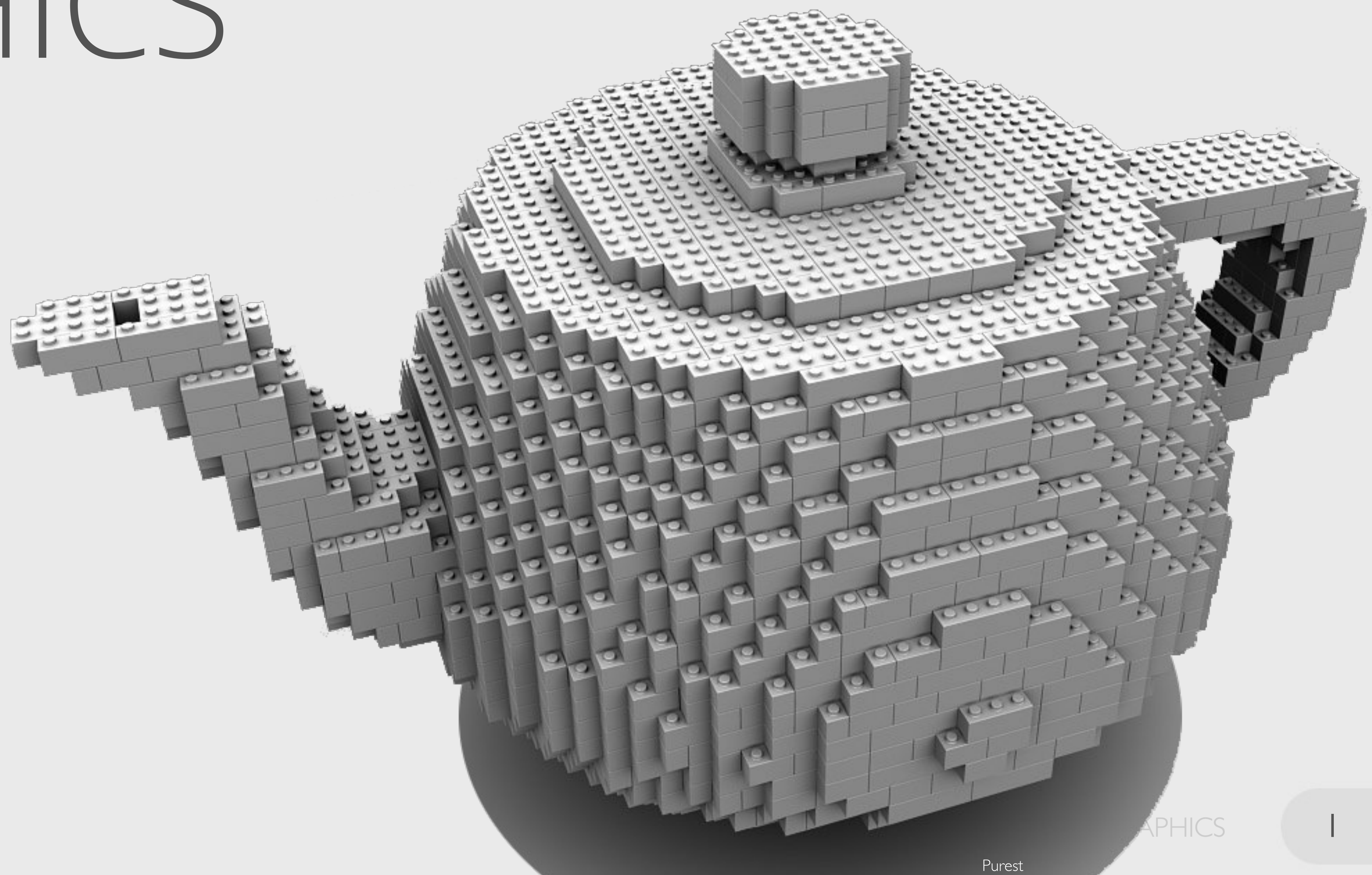
RAY TRACING

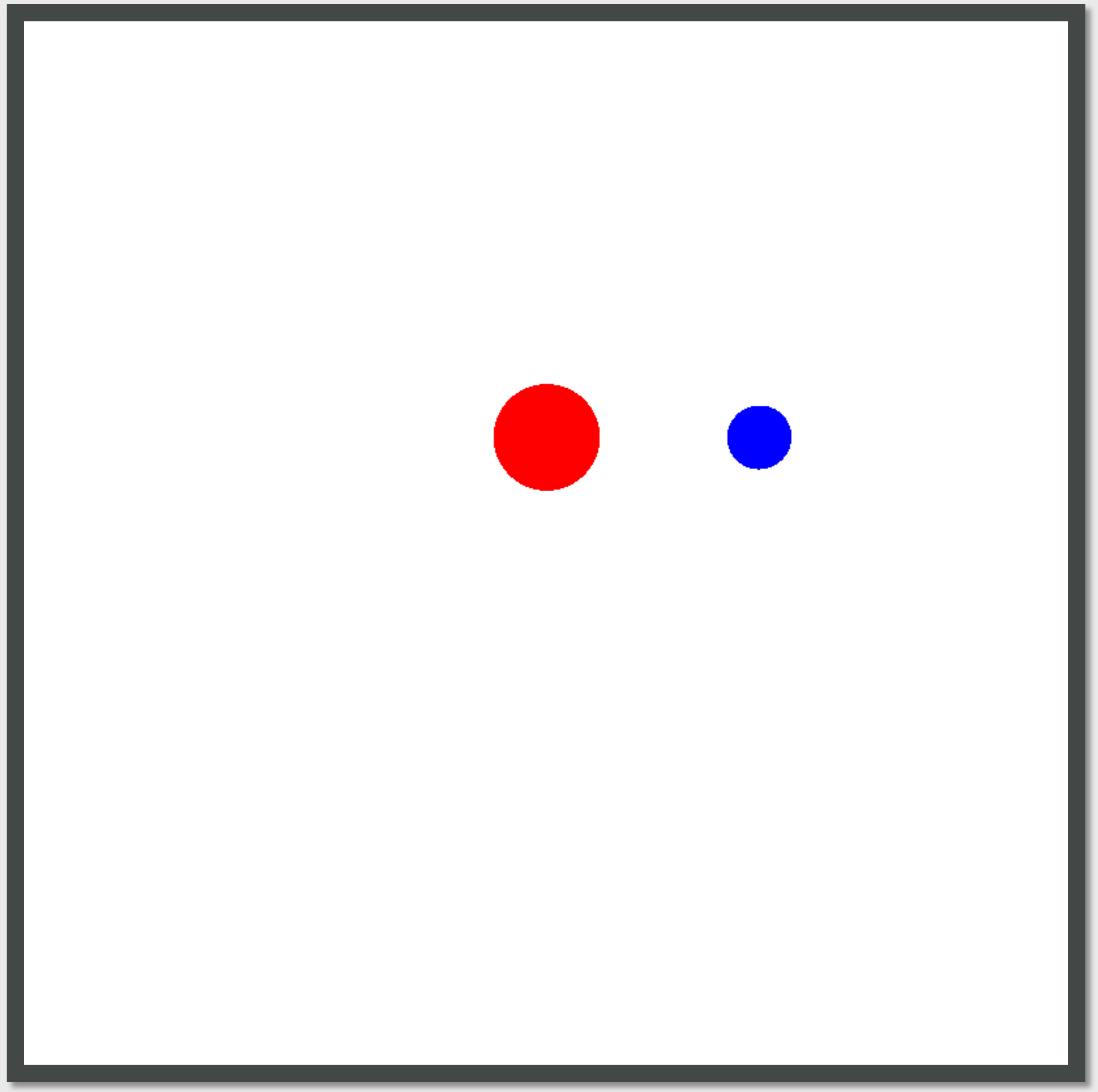


Purest

RAYTRACER v0.1

Objective:

Render flat spheres

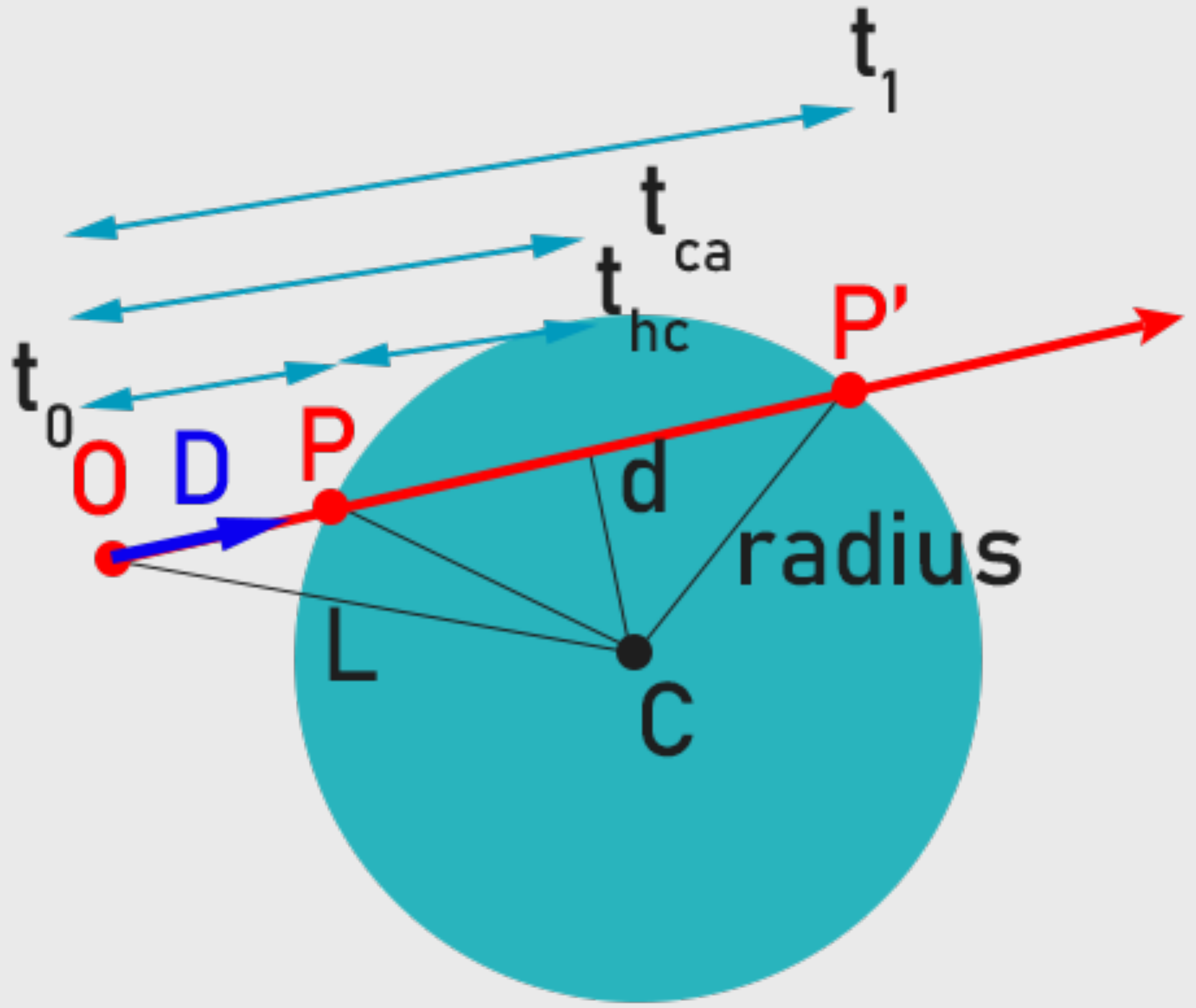


RAYTRACER v0.1

Intersection ray – sphere

Analytic solution

Geometric solution



ANALYTIC SOLUTION

Ray equation

O + tD = Point

Origin of the ray

Direction of the ray

Distance

Sphere equation

$x^2 + y^2 + z^2 = R^2$

Point in position x, y, z

Radius

ANALYTIC SOLUTION

[1] $O + tD$ [2] $x^2 + y^2 + z^2 = R^2$

$P^2 - R^2 = 0$

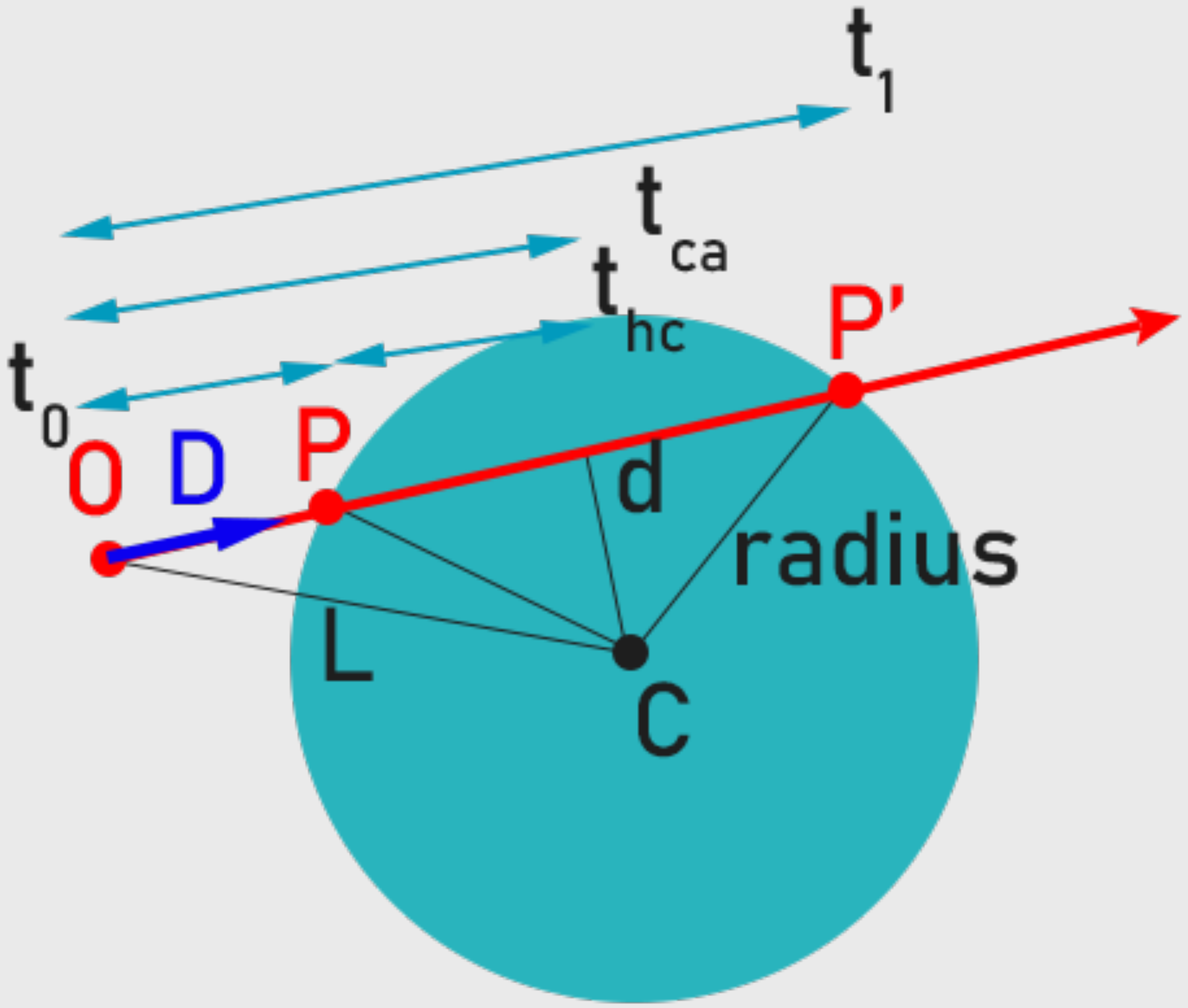
$|O + tD|^2 - R^2 = 0$ [3] $O^2 + (tD)^2 + 2OtD - R^2 = O^2 + t^2D^2 + 2OtD - R^2 0$

Which follow the form of $f(x) = ax^2 + bx + c$

$a = D^2$ $b = 2OD$ $c = O^2 - R^2$ which is solved by $x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$

$\Delta = b^2 - 4ac$ if ($\Delta > 0$):2 points if ($\Delta == 0$):1 point if ($\Delta < 0$):no points

GEOMETRIC SOLUTION



GEOMETRIC SOLUTION

Equation

$O + t_0 D = \text{Point}_0$

$O + t_1 D = \text{Point}_1$

Origin of the ray

Direction of the ray

Distance

Center of the Sphere

$L = C - O$

$t_{ca} = L \cdot D$

if($t_{ca} < 0$) no collision

$d^2 + t_{ca}^2 = L^2$

$d = \sqrt{L^2 - t_{ca}^2} = \sqrt{L \cdot L - t_{ca} \cdot t_{ca}}$

if($d < 0$) no collision

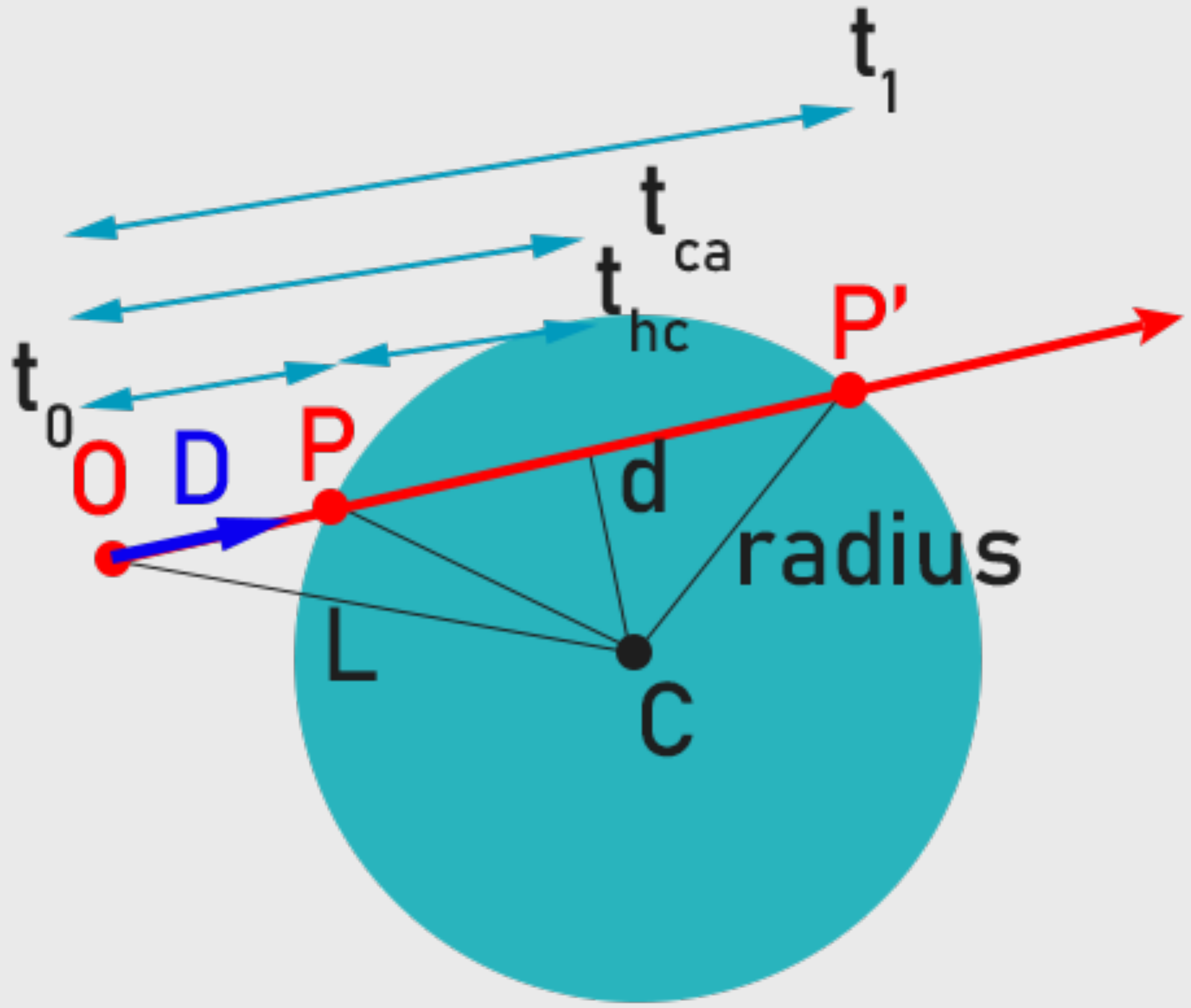
GEOMETRIC SOLUTION

$$d^2 + t_{hc}^2 = radius^2$$

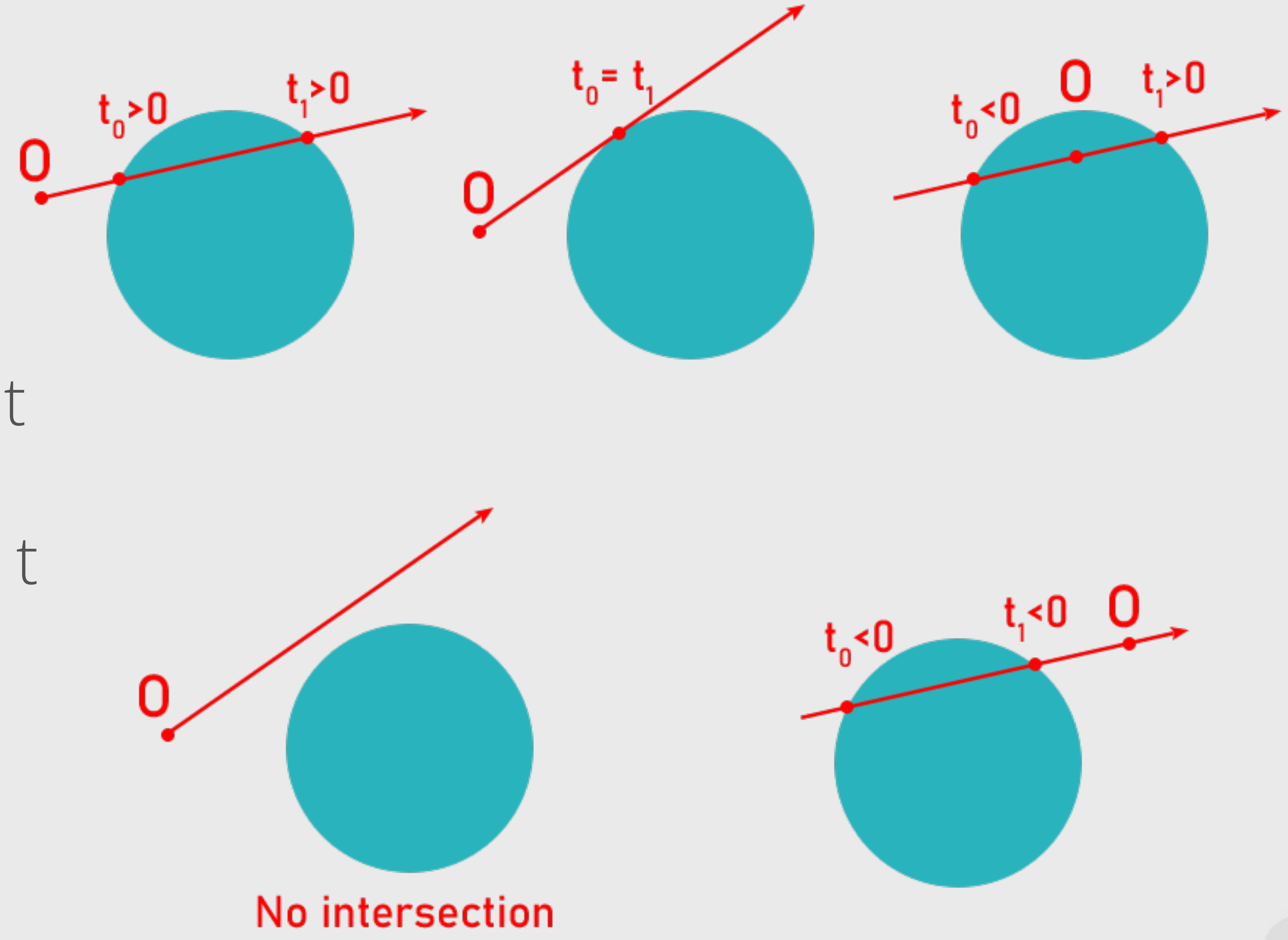
$$t_{hc} = \sqrt{radius^2 - d^2}$$

$$t_0 = t_{ca} - t_{hc}$$

$$t_1 = t_{ca} + t_{hc}$$



SOLUTION



Collision in front is positive t

Collision behind is negative t

RAYTRACER v0.1

Classes required:

Vector3D

Intersection

Ray

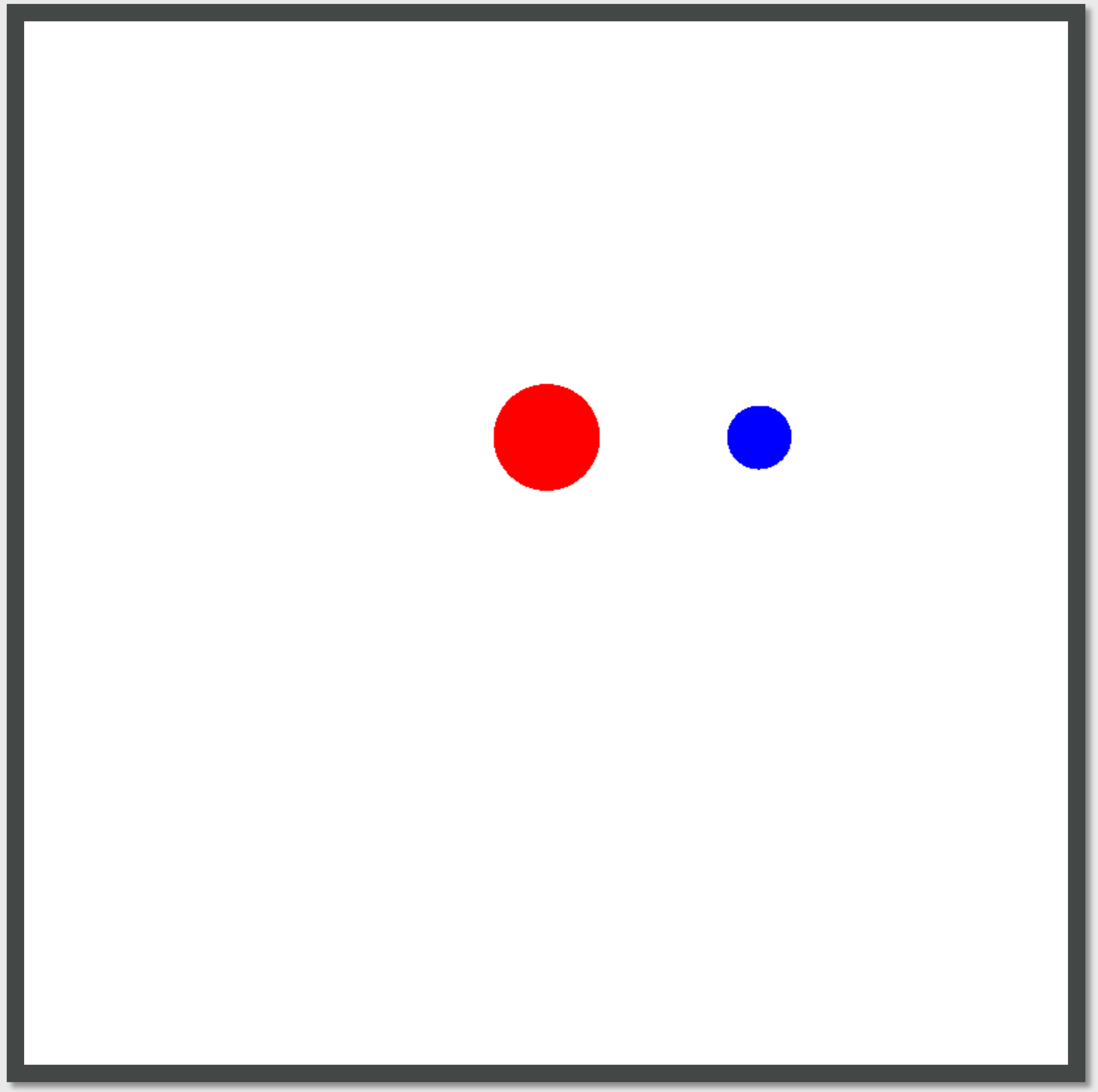
Object3D

Camera

Sphere

Scene

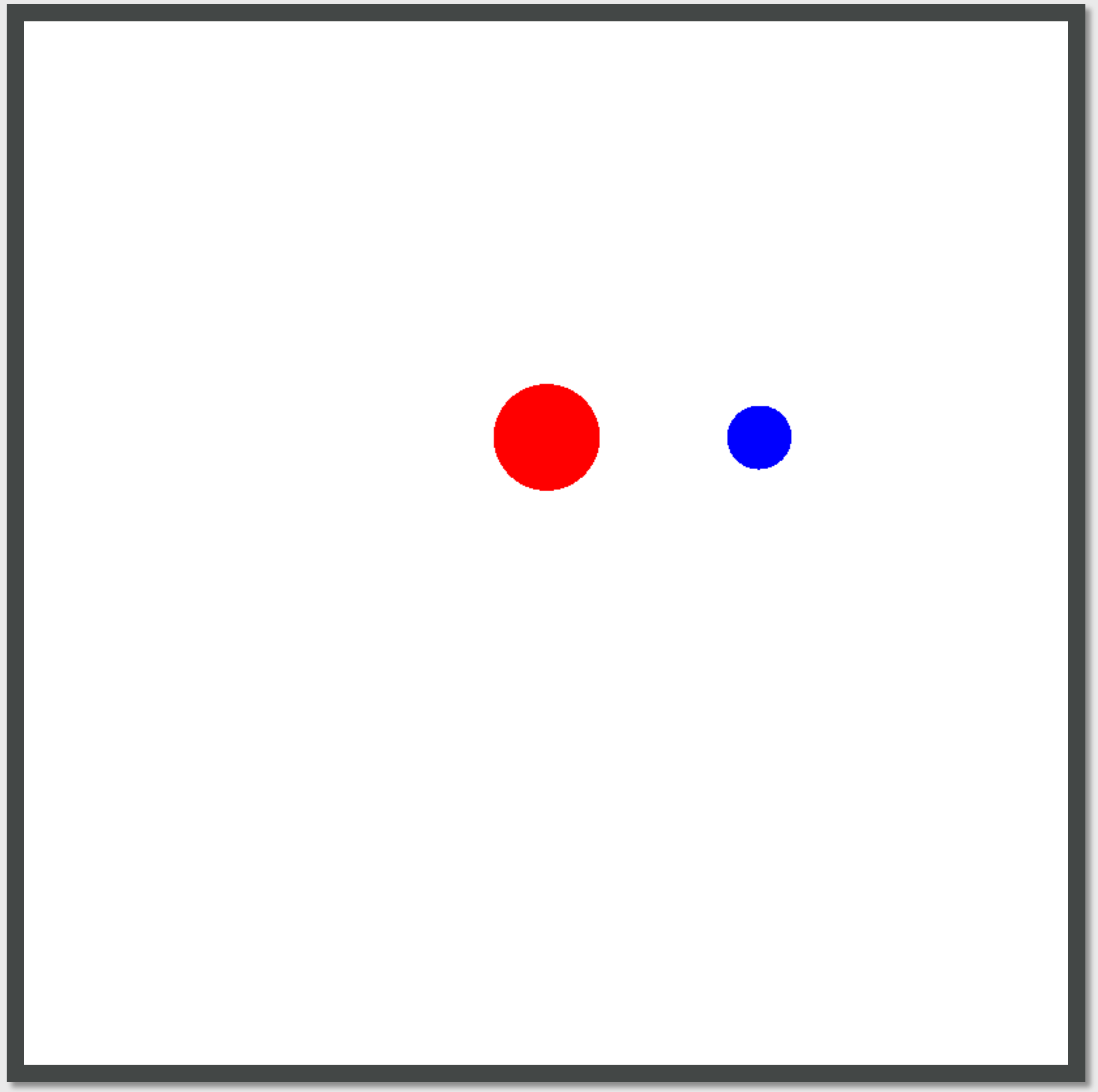
Raytracer



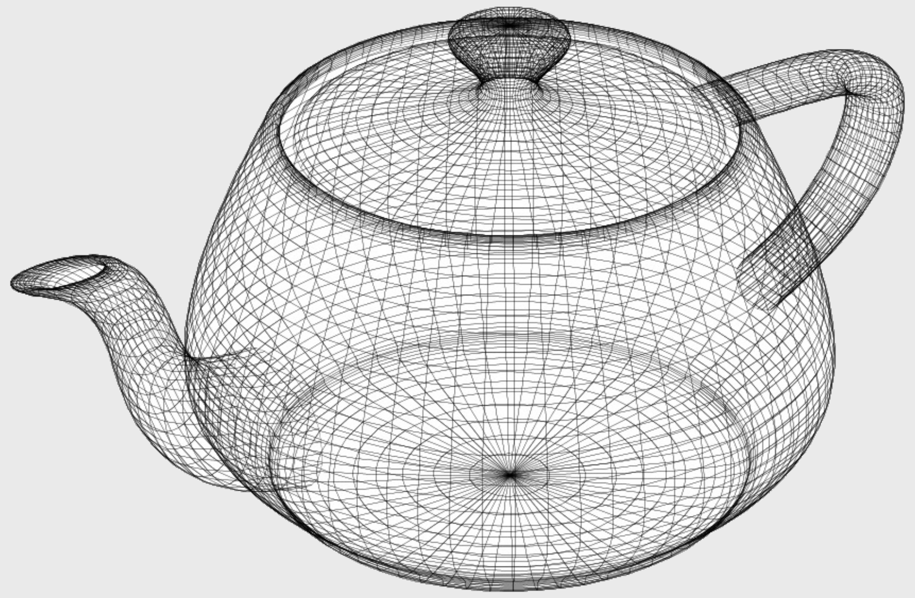
HW

Objective:

Render flat spheres



REFLECTION



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