

# Assignment 01

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Computer Graphics

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## 1 Derivation for the Cylinder Intersections

The implicit representation of a cylinder goes as

$$\|(x - c) \times \vec{a}\|^2 - r^2 = 0$$

Where  $\vec{a}$  is the direction of the cylinder from the center

We plug in the ray parametrization form

$$x = t \cdot \vec{d} + o$$

therefore we get

$$\|(t \cdot \vec{d} + o - c) \times \vec{a}\|^2 - r^2 = 0$$

resulting in the final form

$$t^2 \cdot \|\vec{d} \times \vec{a}\|^2 + t \cdot 2(\vec{d} \times \vec{a})(o - c) \times \vec{a} + \|(o - c) \times \vec{a}\|^2 - r^2 = 0$$

## 2 Derivation for the Cylinder Intersection Normal

The normal which points from the cylinder outwards at point  $x$  can be calculated by two consecutive cross products:

$$\vec{n} = \frac{(\vec{a} \times (x - c)) \times \vec{a}}{\|(\vec{a} \times (x - c)) \times \vec{a}\|}$$