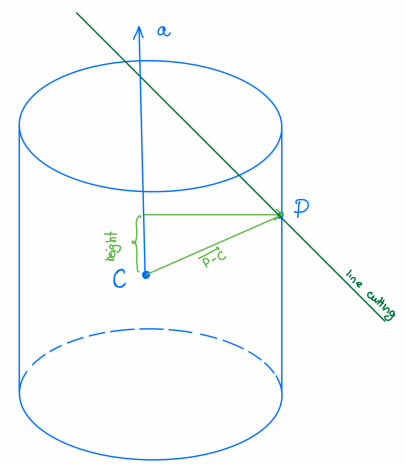


Computer Graphics

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Task RT1.2.1



We will find the intersection of a cylinder with the ray at a point P.
To find this point, will try to find its position from the center of the cylinder C.

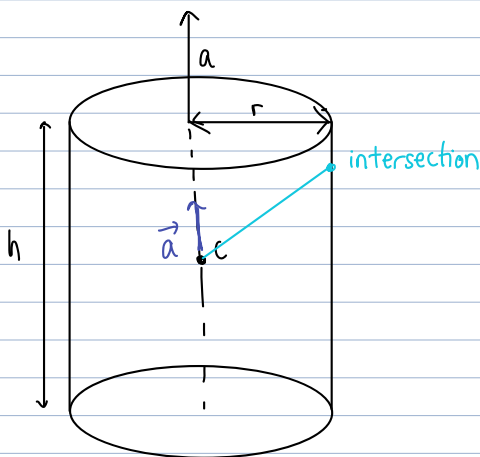
$$\sqrt{\text{dist}^2} = \sqrt{\|O + td - C\|^2 - \text{dot}(O + td - C, a)^2} \quad \text{To find the height (cf drawing), we take the dot product of } P-C \text{ and } a, \text{ replacing } P \text{ by the ray equation } O + td$$

distance p-c

$$= \sqrt{\text{dot}(O + td - C, O + td - C) - \text{dot}(O + td - C, a)^2}$$

$$\text{dist} = \left[\text{dot}(O, O) + \text{dot}(O, td) - \text{dot}(O, C) + \text{dot}(td, O) + \text{dot}(td, td) - \text{dot}(td, C) - \text{dot}(C, O) - \text{dot}(C, td) + \text{dot}(C, C) \right] - \left[\text{dot}(O, a) + \text{dot}(td, a) - \text{dot}(C, a) \right]^2 + 2 \text{dot}(O - C, a) \text{dot}(td, a) + \text{dot}(td, a)^2$$

$$= t^2 (\text{dot}(d, d) - \text{dot}(d, a)^2) + t (2 \text{dot}(d, O) - 2 \text{dot}(d, C) - 2 \text{dot}(O - C, a) \text{dot}(d, a)) + (\text{dot}(O, O) - 2 \text{dot}(O, C) + \text{dot}(C, C) - \text{dot}(O - C, a)^2 - R^2)$$



$$\vec{a} \times (\vec{a} \times \text{intersection} - C) = \text{normal}$$