Computer Graphics: Assignment 04

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2. Analytical Geometry

Equation for sphere: $||\mathbf{x} - M||^2 = r^2$
Equation for ray: $\mathbf{x} = \mathbf{o} + t\mathbf{d}$
Combine and plug in values:

$$||\mathbf{o} + t\mathbf{d} - \mathbf{M}||^2 = r^2$$
$$\mathbf{d}^2 t^2 + 2\mathbf{d}(\mathbf{o} - \mathbf{M})t + |\mathbf{o} - \mathbf{M}|^2 - r^2 = 0$$
$$\rightarrow a = \mathbf{d}^2 = 2,\ b = 2\mathbf{d}(\mathbf{o} - \mathbf{M}) = -20,\ c = |\mathbf{o} - \mathbf{M}|^2 - r^2 = 42$$
$$t_{1/2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{20 \pm \sqrt{400 - 4 \cdot 2 \cdot 42}}{2 \cdot 2}$$
$$t_1 \approx 7 \rightarrow \mathbf{x}_1 = \begin{pmatrix} 7 \\ 7 \\ 1 \end{pmatrix}$$
$$t_2 \approx 3 \rightarrow \mathbf{x}_2 = \begin{pmatrix} 3 \\ 3 \\ 1 \end{pmatrix} \leftarrow \text{this one is visible to the observer}$$