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:

$$||\mathbf{o} + t\mathbf{d} - M||^2 = r^2$$

$$\rightarrow \mathbf{o} + t\mathbf{d} - M = \begin{pmatrix} t-5 \\ t-5 \\ -1 \end{pmatrix}$$

$$\sqrt{(t-5)^2 + (t-5)^2 + 1} = 9$$

$$\sqrt{2t^2 - 20t + 51} - 9 = 0$$

$$2t^2 - 20t - 30 = 0$$

$$\rightarrow a = 2,\ b = -10,\ c = -30$$

$$t_{1/2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{10 \pm \sqrt{100 + 4 \cdot 2 \cdot 30}}{2 \cdot 2} \qquad = \frac{5 \pm \sqrt{85}}{2}$$

$$t_1 \approx -2.11 \rightarrow \mathbf{x}_1 = \begin{pmatrix} -2.11 \\ -2.11 \\ 1 \end{pmatrix}$$

$$t_2 \approx 7.11 \rightarrow \mathbf{x}_2 = \begin{pmatrix} 7.11 \\ 7.11 \\ 1 \end{pmatrix}$$