

Material

$$K_a = 0.7$$

$$K_d = 0.5$$

$$K_s = 0.3$$

$$I_{\text{emissive}} = \begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix}$$

$$ns = 10.5$$

Light

$$I_a = (100, 100, 100)$$

$$I_d = (120, 250, 10)$$

$$I_s = (200, 200, 200)$$

$$I_{\text{fog}} = (127, 127, 127)$$

$$z_{\text{near}} = 2, \quad z_{\text{far}} = 30$$

$$c_1 = 1.0, \quad c_2 = 0.5, \quad c_3 = 0.25$$

$$\textcircled{1} \quad \vec{L} = \text{Light} - A = \begin{bmatrix} 20 \\ 7 \\ 7 \end{bmatrix} - \begin{bmatrix} 10 \\ 5 \\ 5 \end{bmatrix} = \begin{bmatrix} 10 \\ 2 \\ 2 \end{bmatrix} \quad \therefore d_L = 10.198$$

$$\therefore \hat{L} = \begin{bmatrix} 0.981 \\ 0.196 \end{bmatrix}$$

$$\textcircled{2} \quad \vec{V} = C - A = \begin{bmatrix} 7 \\ 12 \\ 5 \end{bmatrix} - \begin{bmatrix} 10 \\ 5 \\ 5 \end{bmatrix} = \begin{bmatrix} -3 \\ 7 \\ 7 \end{bmatrix} \quad \therefore |\vec{V}| = 7.616$$

$$\therefore \hat{V} = \begin{bmatrix} -0.394 \\ 0.919 \end{bmatrix}$$

$$\textcircled{3} \quad \hat{R} = 2(\hat{N} \cdot \hat{L}) \hat{N} - \hat{L} = 2(0.196) \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} 0.981 \\ 0.196 \end{bmatrix} = 0.196$$

$$\therefore \hat{R} = \begin{bmatrix} -0.981 \\ 0.196 \end{bmatrix}$$

$$\textcircled{4} \quad I_{\text{ambient}} = I_a K_a = \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix} \cdot (0.7) = \begin{bmatrix} 70 \\ 70 \\ 70 \end{bmatrix}$$

$$\textcircled{5} \quad I_{\text{diffuse}} = I_d \cdot K_d \cdot \max(\hat{N} \cdot \hat{L}, 0) \\ = \begin{bmatrix} 120 \\ 250 \\ 10 \end{bmatrix} \cdot (0.5) \cdot (0.196) = \begin{bmatrix} 11.760 \\ 24.500 \\ 0.980 \end{bmatrix}$$

$$\textcircled{6} \quad I_{\text{specular}} = I_s \cdot K_s \cdot \max(\hat{R} \cdot \hat{V}, 0)^{ns} \\ = \begin{bmatrix} 200 \\ 200 \\ 200 \end{bmatrix} (0.3) (0.567)^{10.5} \\ = \begin{bmatrix} 0.155 \\ 0.155 \\ 0.155 \end{bmatrix} \\ \hat{R} \cdot \hat{V} = \begin{bmatrix} -0.981 \\ 0.196 \end{bmatrix} \cdot \begin{bmatrix} -0.394 \\ 0.919 \end{bmatrix} \\ = 0.567$$

$$\textcircled{7} \quad I_{\text{local}} = I_{\text{emissive}} + \text{Att} \cdot (I_{\text{ambient}} + I_{\text{diffuse}} + I_{\text{specular}})$$

$$\therefore \text{Att} = \min \left(\frac{1}{C_1 + C_2 d_L + C_3 d_L^2}, 1.0 \right) \\ = \min \left(\frac{1}{1 + (0.5)(10.198) + (0.25)(10.198)^2}, 1.0 \right) = \frac{1}{32.099} \\ = \boxed{0.031}$$

$$\therefore I_{\text{local}} = \begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} + (0.031) \begin{bmatrix} 70 \\ 70 \\ 70 \end{bmatrix} + \begin{bmatrix} 11.760 \\ 24.500 \\ 0.980 \end{bmatrix} + \begin{bmatrix} 0.155 \\ 0.155 \\ 0.155 \end{bmatrix} \quad (2)$$

$$= \begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} + (0.031) \begin{bmatrix} 81.915 \\ 94.655 \\ 71.135 \end{bmatrix}$$

$$= \begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} + \begin{bmatrix} 2.539 \\ 2.934 \\ 2.205 \end{bmatrix} = \begin{bmatrix} 12.539 \\ 12.934 \\ 12.205 \end{bmatrix}$$

$$(8) \quad S = \frac{3_{\text{far}} \cdot |V|}{3_{\text{far}} - 3_{\text{near}}} = \frac{30 - 7.616}{30 - 2} = 0.799$$

$$\therefore I_{\text{final}} = (S) I_{\text{local}} + (1-S) I_{\text{fog}}$$

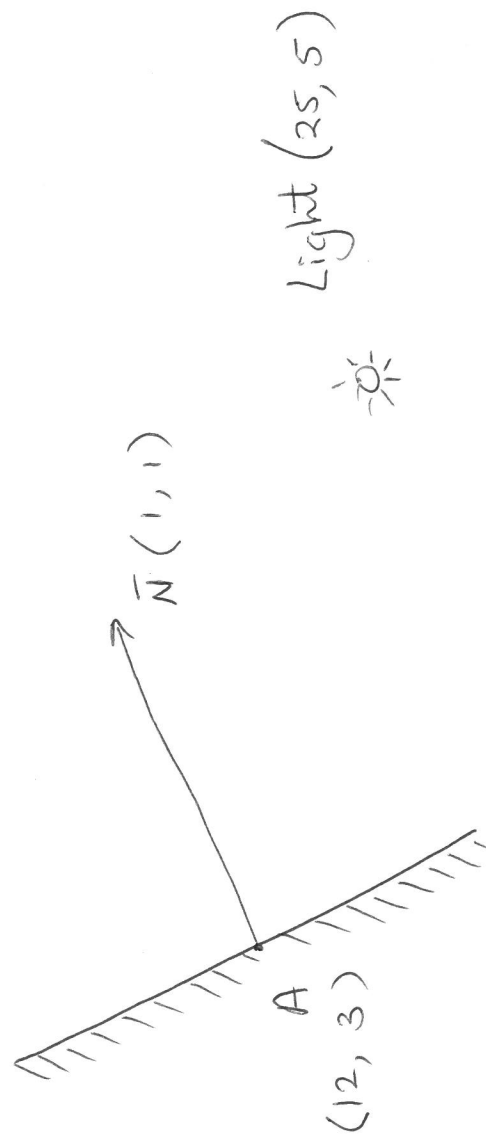
$$= (0.799) \begin{bmatrix} 12.539 \\ 12.934 \\ 12.205 \end{bmatrix} + (0.201) \begin{bmatrix} 12.7 \\ 12.7 \\ 12.7 \end{bmatrix}$$

$$= \begin{bmatrix} 35.546 \\ 35.861 \\ 35.279 \end{bmatrix} \Rightarrow \begin{bmatrix} 36 \\ 36 \\ 35 \end{bmatrix}$$

Fragment
value

FB/Display
value

$C(10, 10)$



Material

$K_d = 0.7$

$K_d = 0.3$

$K_s = 0.9$

$ms = 2$

$I_{\text{emissive}} = \begin{bmatrix} 200 \\ 100 \\ 100 \end{bmatrix}$

Light

$I_a = (150, 150, 150)$

$I_d = (200, 225, 175)$

$I_s = (75, 200, 250)$

$I_{\text{fog}} = (100, 100, 100)$

$z_{\text{near}} = 3, z_{\text{far}} = 25$

$c_1 = 2.0, c_2 = 0.15, c_3 = 0.75$

① $\vec{L} = \text{Light} - A = \begin{bmatrix} 25 \\ 5 \\ 5 \end{bmatrix} = \begin{bmatrix} 12 \\ 3 \\ 2 \end{bmatrix} \therefore d_L = 13.153$

$\therefore \hat{L} = \begin{bmatrix} 0.988 \\ 0.152 \end{bmatrix}$

② $\vec{V} = C - A = \begin{bmatrix} 10 \\ 10 \\ 3 \end{bmatrix} = \begin{bmatrix} -2 \\ 7 \end{bmatrix} \therefore |\vec{V}| = 7.280$

$\therefore \hat{V} = \begin{bmatrix} -0.275 \\ 0.962 \end{bmatrix}$

③ $\hat{R} = 2(\hat{N} \cdot \hat{L})\hat{N} - \hat{L}$
 $= 2(0.806) \begin{bmatrix} 0.707 \\ 0.707 \end{bmatrix} - \begin{bmatrix} 0.988 \\ 0.152 \end{bmatrix}$
 $\hat{R} = \begin{bmatrix} 0.152 \\ 0.988 \end{bmatrix}$

$\hat{N} \cdot \hat{L} = \begin{bmatrix} 0.707 \\ 0.707 \end{bmatrix} \cdot \begin{bmatrix} 0.988 \\ 0.152 \end{bmatrix} = 0.806$

$$\textcircled{4} \quad I_{\text{ambient}} = I_a K_a = \begin{bmatrix} 150 \\ 150 \\ 150 \end{bmatrix} (0.7) = \begin{bmatrix} 105 \\ 105 \\ 105 \end{bmatrix}$$

$$\textcircled{5} \quad I_{\text{diffuse}} = I_d K_d \max(\hat{N} \cdot \hat{L}, 0) = \begin{bmatrix} 200 \\ 225 \\ 175 \end{bmatrix} (0.3) (0.806)$$

$$= \begin{bmatrix} 48.360 \\ 54.405 \\ 42.315 \end{bmatrix}$$

$$\textcircled{6} \quad I_{\text{specular}} = I_s K_s \max(\hat{R} \cdot \hat{V}, 0)^{ns}$$

$$\hat{R} \cdot \hat{V} = \begin{bmatrix} 0.152 \\ 0.988 \end{bmatrix} \cdot \begin{bmatrix} -0.275 \\ 0.962 \end{bmatrix}$$

$$= 0.909$$

$$= \begin{bmatrix} 75 \\ 200 \\ 250 \end{bmatrix} (0.9) (0.909)^2$$

$$= \begin{bmatrix} 55.774 \\ 148.731 \\ 185.913 \end{bmatrix}$$

$$\textcircled{7} \quad Att = \min \left(\frac{1}{c_1 + c_2 d_c + c_3 d_c^2}, 1.0 \right)$$

$$= \min \left(\frac{1}{2 + (0.15)(13.153)} + (0.75)(13.153)^2, 1.0 \right)$$

$$= 0.007$$

$$I_{\text{local}} = I_{\text{emissive}} + Att * \left\{ I_{\text{ambient}} + I_{\text{diffuse}} + I_{\text{specular}} \right\}$$

$$= \begin{bmatrix} 200 \\ 100 \\ 100 \end{bmatrix} + (0.007) \left\{ \begin{bmatrix} 105 \\ 105 \\ 105 \end{bmatrix} + \begin{bmatrix} 48.360 \\ 54.405 \\ 42.315 \end{bmatrix} + \begin{bmatrix} 55.774 \\ 148.731 \\ 185.913 \end{bmatrix} \right\}$$

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$$\therefore T_{local} = \begin{bmatrix} 200 \\ 100 \\ 100 \end{bmatrix} + (0.007) \begin{bmatrix} 209.134 \\ 308.136 \\ 333.228 \end{bmatrix}$$

$$= \begin{bmatrix} 201.464 \\ 102.157 \\ 102.333 \end{bmatrix}$$

$$\textcircled{8} \quad S = \frac{z_{far} - |V|}{z_{far} - z_{near}} = \frac{25 - 7.280}{25 - 3} = \frac{17.720}{22} = 0.805$$

$$I_{final} = (S) I_{local} + (1-S) I_{fog}$$

$$= (0.805) \begin{bmatrix} 201.464 \\ 102.157 \\ 102.333 \end{bmatrix} + (0.195) \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix}$$

$$= \begin{bmatrix} 181.679 \\ 101.736 \\ 101.878 \end{bmatrix} \Rightarrow \begin{bmatrix} 182 \\ 102 \\ 102 \end{bmatrix}$$

Fragment

Color

Display / FB

color.

