

CPSC314 Assignment 3 Written

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In[66]:=

Question 1

$$N_e = \{-0.89, -0.45, 0, 0\}$$

$$N_F = \{0.16, -0.99, 0, 0\}$$

$$\text{Normalize}[N_F + N_e] = \{-0.452161931646686, -0.8919358651660655, 0., 0.\}$$

Question 2

Point B

$$I_A K_A = \{0.1^\circ, 0.1^\circ, .2\} \{.9, .5, .5\} = \{0.09000000000000001^\circ, 0.05^\circ, 0.1^\circ\}$$

$$I_D = K_D I_L(n.l)$$

$$l = \{1, 1, 0, 1\} - \{3, 4, 0, 1\} = \left\{ -\frac{2}{\sqrt{13}}, -\frac{3}{\sqrt{13}}, 0, 0 \right\}$$

$$(n.l) = \left\{ -\frac{2}{\sqrt{13}}, -\frac{3}{\sqrt{13}}, 0, 0 \right\} \cdot \{-0.452161931646686, -0.8919358651660655, 0., 0.\} = 0.9929498113518995^\circ$$

$$I_D = \{.2, .8, .3\} * \{1, 1, 1\} * .9830 = \{0.1966^\circ, 0.7864^\circ, 0.2949^\circ\}$$

$$I_S = K_S I_L(v.r)^n$$

$$v = \{1, 2, 0, 1\} - \{3, 4, 0, 1\} = \{-2, -2, 0, 0\} = \left\{ -\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}, 0, 0 \right\}$$

$$r = 2(n(n.1)) - 1 = 2 * \{-4522, -8919, 0, 0\} * .9830 - \{-5546, -8321, 0, 0\} = \\ \{-0.3344252^\circ, -0.9213754000000002^\circ, 0., 0.\} = \{-0.3411839840606065^\circ, -0.9399965367066688^\circ, 0., 0.\}$$

$$v.r = 0.9059314341586526^\circ$$

$$I_S = \{1, .5, 1\} * \{1, 1, 1\} * 0.9059314341586526^{20} = \\ \{0.13864575683812463^\circ, 0.06932287841906232^\circ, 0.13864575683812463^\circ\}$$

$$I = I_A K_A + I_D + I_S = \{0.42524575683812466^\circ, 0.9057228784190623^\circ, 0.5335457568381247^\circ\}$$

Point C

$$I_A K_A = \text{Same as point } B.$$

$$I_D = K_D I_L(n.l)$$

$$l = \{1, 1, 0, 1\} - \{9, 6, 0, 1\} = \left\{ -\frac{8}{\sqrt{89}}, -\frac{5}{\sqrt{89}}, 0, 0 \right\}$$

$$N_c = \frac{\{.97, .52, 0, 0\}}{1.1006} = \{0.881337452298746^\circ, 0.47246956205705976^\circ, 0^\circ, 0^\circ\}$$

$$(n.l) = 0.8813 * -0.8480 + 0.4725 * -0.5300 = -0.9977674^\circ$$

Because $n.l < 0$

$$I_D = 0$$

$$v = \{1, 1, 0, 1\} - \{9, 6, 0, 1\} = \{-8, -5, 0, 0\} = \left\{ -\frac{8}{\sqrt{89}}, -\frac{5}{\sqrt{89}}, 0, 0 \right\}$$

$$\begin{aligned} r &= 2 * \{0.881337452298746^\circ, 0.47246956205705976^\circ, 0^\circ, 0^\circ\} * -0.9977674^\circ - \{-0.8480, -0.5300, 0, 0\} = \\ &\quad \{-0.9107395566054878^\circ, -0.41282945302562224^\circ, 0^\circ, 0^\circ\} = \\ &\quad \{-0.9107966210531458^\circ, -0.41285531978911466^\circ, 0^\circ, 0^\circ\} \end{aligned}$$

$$v.r = 0.9911668718095372^\circ$$

$$\begin{aligned} I_S &= \{1, .5, 1\} \{1, 1, 1\} (0.9911668718095372^\circ)^{20} = \\ &\quad \{0.8374050200161897^\circ, 0.41870251000809483^\circ, 0.8374050200161897^\circ\} \end{aligned}$$

$$\begin{aligned} I &= I_A K_A + I_S = \\ &\quad \{0.09000000000000001^\circ, 0.05^\circ, 0.1^\circ\} + \{0.8374050200161897^\circ, 0.41870251000809483^\circ, 0.8374050200161897^\circ\} = \\ &\quad \{0.9274050200161896^\circ, 0.4687025100080948^\circ, 0.9374050200161896^\circ\} \end{aligned}$$

Point D

flat shading using rightmost point is $I(d)=I(c)$

$$\text{In[51]:= } I = \{0.9274050200161896^\circ, 0.4687025100080948^\circ, 0.9374050200161896^\circ\}$$

Question 3

Point B and Point C still uses the vertices so they are the same as flat shading

$$I_B = \{0.42524575683812466^\circ, 0.9057228784190623^\circ, 0.5335457568381247^\circ\}$$

In[53]:= $I_C = \{0.9274050200161896^\circ, 0.4687025100080948^\circ, 0.9374050200161896^\circ\}$

I_D is linearly interpolated between $I_B = I_C$

$$I_D = \frac{1}{2} I_B + \frac{1}{2} I_C = \{0.6763253884271572^\circ, 0.6872126942135786^\circ, 0.7354753884271572^\circ\}$$

Question 4

Points B and C are still the same as in flat shading

In[56]:= $I_B = \{0.42524575683812466^\circ, 0.9057228784190623^\circ, 0.5335457568381247^\circ\}$

$I_C = \{0.9274050200161896^\circ, 0.4687025100080948^\circ, 0.9374050200161896^\circ\}$

I_D = Linearly interpolate between N_B and N_C

$$N_D = \frac{(N_B + N_C)}{\text{Norm}[N_B + N_C]} =$$

$$\left(\{-0.452161931646686^\circ, -0.8919358651660655^\circ, 0., 0.\} + \{0.881337452298746^\circ, 0.47246956205705976^\circ, 0., 0.\} \right) /$$

$$\text{Norm}[\{-0.452161931646686^\circ, -0.8919358651660655^\circ, 0., 0.\} + \{0.881337452298746^\circ, 0.47246956205705976^\circ, 0., 0.\}] = \{0.7151499090420432^\circ, -0.6989711064108141^\circ, 0., 0.\}$$

$$l = \{1, 1, 0, 1\} - \{6, 5, 0, 1\} = \{-5, -4, 0, 0\} = \left\{ -\frac{5}{\sqrt{41}}, -\frac{4}{\sqrt{41}}, 0, 0 \right\}$$

$$n.l = -0.12179446948847977^\circ$$

$$v = \{1, 2, 0, 1\} - \{6, 5, 0, 1\} = \left\{ -\frac{5}{\sqrt{34}}, -\frac{3}{\sqrt{34}}, 0, 0 \right\}$$

$$r = 2 * \{0.7151499090420432^\circ, -0.6989711064108141^\circ, 0., 0.\} * -0.12179446948847977^\circ -$$

$$\left\{ -\frac{5}{\sqrt{41}}, -\frac{4}{\sqrt{41}}, 0, 0 \right\} = \{0.60666620189001^\circ, 0.794956677740586^\circ, 0., 0.\}$$

$v.r < 0$ therefore $I_S = 0$

$(n.l) < 0$ therefore $I_D = 0$

$$I_D = I_A I_K = \{0.1^\circ, 0.1^\circ, .2\} \{.9, .5, .5\} = \{0.0900000000000001^\circ, 0.05^\circ, 0.1^\circ\}$$

