

Homework 3: Color Vision
10 Points: Due at beginning of class, Thursday, 12 February 2015

There are two parts to this homework assignment. Each part counts 5 points. Late homework will receive a grade of zero.

Part 1: Two colors are each matched (have identical appearance) by the following color-equations using the C.I.E. Tristimulus X, Y, and Z primaries:

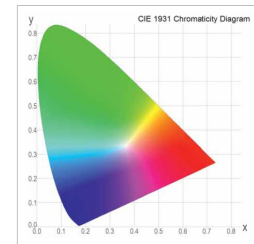
$$C_1 \equiv 6.0 X + 2.00 Y + 2.00 Z$$

$$C_2 \equiv 2.00 X + 6.0 Y + 3.00 Z$$

The C.I.E. chromaticity coordinates, x , y , z , computed from the Tristimulus values are:

$$x = \frac{X}{(X+Y+Z)}, \quad y = \frac{Y}{(X+Y+Z)}, \quad z = \frac{Z}{(X+Y+Z)}$$

Compute the chromaticity coordinates of each color (small x , y , and z). Construct a chromaticity graph by plotting x -chromaticity against y -chromaticity (make the axis scales go from 0 to 1). Compare the chromaticity of the two colors: are they the same or different? How do they differ? Finally, what C.I.E. primaries X, Y, and Z, will match the color C_3 produced when C_1 is added to C_2 ? Plot C_3 on your chromaticity graph. Where does C_3 lie in relation to C_1 and C_2 ?



Part 2: There are three perceptual processes in color vision: two chromatic channels and one achromatic channel. These three processes receive input from the three types of cones approximated by these three equations:

$$rg = 1.89 L - 2.79 M + 0.45 S$$

$$yb = 0.85 L + 0.22 M - 1.72 S$$

$$Lu = 0.85 L + 0.15 M + 0.015 S$$

where S, M, and L are the short, medium, and long wavelength cone types. Assume that the two colors below activate the cones by the following amounts:

	L	M	S
C_4	14.8	22.0	0.2
C_5	20.0	3.0	13.0

Make a graph of the opponent process color space with the x -axis representing $(+r-g)$ and the y -axis representing $(+y-b)$. Both axis scales should run from -50 to $+50$. Compute the activation of the two chromatic channels (ignore luminance) to C_4 , to C_5 , and to a mixture (C_6) of C_4 and C_5 ($C_6 = C_4 + C_5$). Plot each of the three colors as points on the graph (C_4 , C_5 , and C_6). What are the color **appearances** of C_4 and of C_5 ? What is the color **appearance** of the mixture C_6 ?