CS 418 Interactive
Computer Graphics
In-class Worksheet

Color

1. CMY to and from RGB

$$\begin{bmatrix} C \\ M \\ Y \\ 1 \end{bmatrix} = \begin{bmatrix} -1 & & & 1 \\ & -1 & & 1 \\ & & -1 & 1 \\ & & & 1 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \\ 1 \end{bmatrix}$$

a. Convert $(0.25, 0.5, 0.75)_{CMY}$ to the same color in RGB

b. In English, what color is $(1,0,1)_{CMY}$?

c. In English, what color is $(1,0,1)_{RGB}$?

d. How many colors have the same representation in CMY and RGB?

2. How Many Colors?

Suppose we use unsigned 8-bit integers to represent the value of each color channel in an RGB value, so the range is between 0 and 255.

a. How many unique colors can be represented?

b. The human eye can distinguish approximately 10 million different colors. Consider your answer above and what you know about the relationship between RGB space and the CIE XYZ space. What is the relationship between the colors in RGB space and the set of colors perceivable by humans?

3. Gamma Correction

Here's something from a tutorial on gamma in images:

$$y = x^{\left(\frac{1}{2.2} \times 2.2\right)} = x^{1} = x$$

"Discussions around gamma-encoding and histograms on the internet are sometimes confusing. Many articles reference gamma-encoding in relation to the non-linear response of the human vision to luminance, insinuating (or simply just stating) that gamma-encoding has something to do with reconciling this with the linear nature of digital camera sensors. **This is not true**. We never see the gamma encoded image—the final image on our screens (or in print) is just what our camera recorded."

From https://www.japanistry.com/understanding-gamma-in-photography/

Is this claim true? Consider that raw camera images use anywhere from 12 to 16 bits per color channel and typical image formats use 8 bits. See if you can draw on the images below to show the difference in applying gamma encoding before reducing the bit depth and not encoding with gamma before reducing the bit depth.