**ENGR 101 Tut 3 Part A: Improving Your Image**

The next two tutorial activities are designed to help you develop familiarity with computer image technology and practice work with binary numbers. This is the first half. You will meet these ideas in ENGR 101, COMP 102, and in CGRA 151 next term.

**Introduction**  
Just as our sound technology is developed to work with the human ear, our image technology is developed to work with the human eye. We will develop a number of concepts related to this during this tutorial.

**CORE**

**Binary math’s Review**

* Add 17 + 13 as decimals.

17+13=30

* Add 17 + 13 as unsigned 8-bit binaries.

11110

* Add 255 + 17 as decimals.

255+17=272

* Add 255 + 17 as unsigned 8-bit binaries.

**10101100**

**One-way Mirror box**   
You may have seen the one-way mirror demonstrations at orientation or open day. If not, have a look at the video of the Candle-Under-Water demonstration.

**Computer Colors**Download the ComputerColours java folder and extract to a convenient place. Launch the program.

Set R=255 and G = 255 to make yellow. Have a look with a strong magnifier and see that it is not really yellow, but rather red and green.

**Color mixing**It is simply incorrect that high frequency green light and low frequency red light mix to make medium frequency yellow light. Based on the tutor’s presentation, explain how human color perception works and why red and green appear to make yellow.

Human Color perception works as light travels into the eye to the retina. The retina is covered with sensitive cells called rods and cones. When the cells detect light, they send signals to the brain. The cones in the retinas help detect colors.

**Spectra and Perceptive Colors**

Colors that are part of the spectrum, true mid-wavelength yellow for example, are called ***spectral*** colors. Colors that are simulated by a mix of other colors are called ***perceptive*** colors.

**Computer Colors**

1. Adjust the amounts of red, green, and blue and observe the results.
2. Find values of RGB that simulate pink and brown

Pink: R-255 G-0 B-255

Brown: R-95 G-63 B-0

Is the yellow we made perceptive yellow or spectral yellow? Are the pink and brown perceptive or spectral? Which colors on a computer screen are spectral and which are perceptive? Explain.

Spectral is a color that is evoked in a typical human by a single wavelength of light in the visible spectrum. Perceptive are colors that look different depending on the light/color settings.

Pink and brown are perceptive color. Yellow is spectral

**COMPLETION  
Color Numbers**

1. What range of values can each color take? What is the significance of this?

0-255 range of values one byte of unsigned integer one byte per color per pixel.

Also, enough levels.

Each color component value can be written as a percentage or a decimal. In computers, the component values are often stored as unsigned integer numbers ranging from 0-222 which is the range that a single 8-bit byte can offer.

1. Turn on the color number display by pushing the display 24-bit color number button. Write down the formula for a color number. Can you explain why it is set up this way? What is the number corresponding to white? What would the number for white be in binary? For red? For green? For Blue? For Black?

Formula for color in 24-bit: (256\*256\*R) + (256\*G) + (B)=\_\_\_\_. Each level is measured by the range of 0-255 and is a range of the mixture of RGB (primary colors).

(White formula = 16777215, 0111111111111111111111111),

(Red formula = 16711680, 111111110000000000000000),

(Green formula = 65280, 1111111100000000),

(Blue formula = 255, 11111111),

1. The software shows 24-bit (or 3 byte) color, but computers are usually said to use 32-bit color. How are these related?

In most cases where computers use 32-bit color they assign 24 bits to the color, and the remaining 8 bits are the alpha channel or unused. 24-bits produce around 16.6 million colors and 32-bits produce around 16,777,215.

**What is an image anyway?**

As a demonstration we will use the ExcelImage software to make an image of an example .csv file. Explain the results. Nearly any numerical data can be displayed as an image, and we are used to seeing this. We might see a false-color image of temperature versus 2 D position, magnetic field versus 2 D position, and so on. This is part and parcel of modern scientific data display. So many kinds of data can be displayed in the form of an image. Just use your image-ination! If you get a chance, make up a csv file, predict what it will look like as an image, and test your prediction.

**Images in Standard Software**

Launch Libre Office Writer, make a colour rectangle, right-click on it, click on area, then on the colours tab. See if you can find the RGB controls. Hint: you can select either RGB or CMYK representations. Does it work pretty much the same way ComputerColours works?

**RGB Meets ADC**

Without looking on the internet, describe what you think a colour scanner or digital camera works in terms of RGB and ADC. From what we have learned, what would you say is the bit depth of the ADC? Note this is not correct for all scanners and cameras.

**If time permits:**

Your tutor has enough human eye and vision demonstrations and experiments to keep you busy learning for a very long time. Want to know how eyeglasses work? Blind spots? Colour peripheral vision? Ask. It’s all connected with the technology we use day-to-day, but we do not have time during the tuts.