# 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 maths Review

Add 17 + 13 as decimals.

17 + 13 = 30

Add 17 + 13 as unsigned 8 bit binaries.

0001 0001 + 0000 1101 = 0001 1110

Add 255 + 17 as decimals.

255 + 17 = 272

Add 255 + 17 as unsigned 8 bit binaries.

1111 1111 + 0001 0001 = 0001 0000

### 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 Colours

Download the ComputerColours java folder and extract to a convenient place. Launch the program. See the instructions in the attachment.

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.

### Colour 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 colour perception works and why red and green appear to make yellow.

### Spectra and Perceptive Colours

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

#### Computer Colours

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:240 G:100 B:160

   Brown: R:87 G:25 B:0

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

## COMPLETION

### Colour Numbers

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

   255, this is because the unassigned 8 bit binarys (1 byte) cannot go above 255

   also means each pixel has one byte of data

   cant see the difference if you went higher anyway

   very convenient for programming

2. Turn on the colour number display by pushing the display 24-bit colour number button. Write down the formula for a colour 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?

Color Number = (256*256*R) + (256*G) + (B)

It is set up that way because it shows all the possible combinations for the color sliders. Also preserves the original numbers (bit shifting)

white = 16777215

red = 16711680

green = 65280

blue = 255

black = 0

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

The extra byte is used for transparency, it is irrelevant when it gets from the computer to the screen. It is used for processing images in image software

### What is an image anyway?

As a demonstration we will use the ExcelImage software to make an image of an example .csv fiile. 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-colour 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.