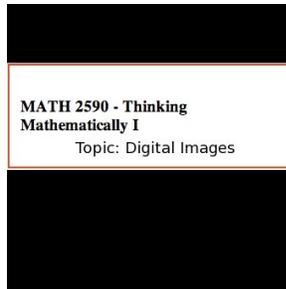


# SCRIPT FOR PODCAST ON DIGITAL IMAGES

MIKE ZABROCKI



Hello and welcome to my first podcast for Math 2590.

My name is Mike Zabrocki and I am going to talk about digital images.

I'd like you to imagine what happens when you click the shutter button on a digital camera to take a photograph.



Somehow what you see in front of you is saved into an image which is displayed on your computer screen.



In this process, that image which your eye perceives as light is picked up by a sensor in the camera and turned into numbers.

Those numbers are then redisplayed on your computer screen as a very good representation of the light that your camera saw when it took that picture.

Technology wasn't always this advanced. Until recently, film cameras were more sophisticated than digital cameras.



Digital images have developed from fairly primitive black and white pictures a few decades ago, to very detailed images. Think of an example like Google Earth which allow you to zoom in on an enormous amount of detail.



When home computers were first available, computer displays generally consisted of a green screen or amber monitor.



The smallest dot on a screen is called a pixel and for those displays a pixel was either on or off. It had no 'color' it was either black or white.

Each pixel on a black and white image represented one bit in memory. Exactly one 0 or 1.

A few early computers were able to display on a television screen, and some of those had the ability to display four colors at the same time.



For these computers, a pixel on the television screen represented two bits and there were four colors because each two bit combination, 00, 01, 10 or 11, could represent a different color.



These computer images had two modes: one where the pixels which were black, red, green, and yellow; and there was another 'mode' where the pixels were black, cyan, magenta, and white.

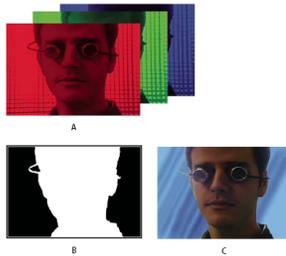
Needless to say, the images that one could create with this medium were quite limited, but new graphics cards were developed allowing computer screens to display more and more colors.



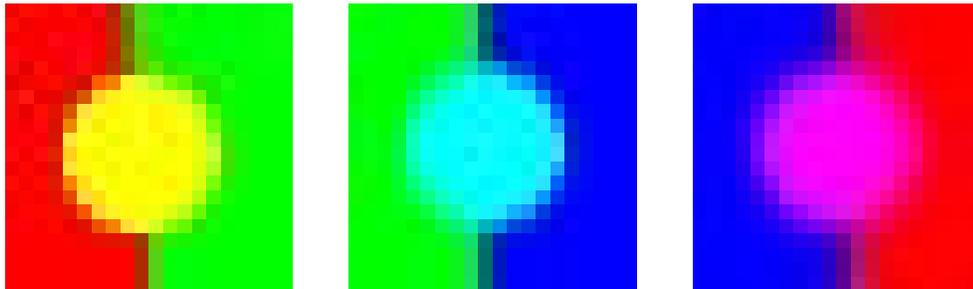
Standards for the number of colors that can be displayed on a computer display haven't changed much in the last few years. They generally represent each pixel of an image by three 8 bit values allowing any one image to contain up to  $2^{24}$  colors in the same image.



An image on the computer screen is stored in a file as a sequence of numbers, each pixel of the image contains a red value, a green value and a blue value.



Other colors are all found by mixing these three with different intensities. Yellow (for instance) is red + green, cyan is green + blue and magenta is red + blue.

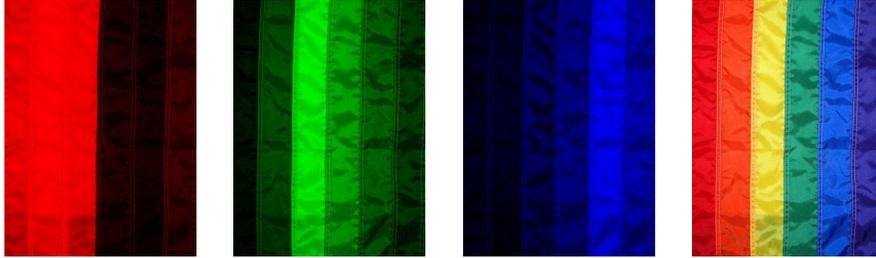


On a computer, certain programs give you the option to display each one of these colors separately. The result is that we can see the intensity of the different colors and the resulting images are called the red, green and blue ‘channels.’

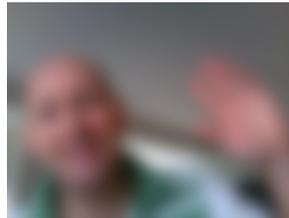
In a black and white photograph (where the colors are different levels of grey), the red, green and blue channels have the same intensity in the same places.



In a color image, there are really three separate images that may look very different when they are superimposed.



When a computer program does transformations on the images such as sharpen, blur, or remove red eye, what is happening is that the program applies mathematical transformations on the pixels.



Consider for instance what happens when a color image is converted into a black and white image.



What happens is that the intensity of the red, green and blue values is averaged out so that the overall intensity is approximately what it was before, just that for each pixel the new red, green and blue values are all the same.

So then how are 3d images made? 3d glasses have two different lenses for each eye. The lens for each eye will filter out some light and let the rest of the light in.



For the 3d glasses that were used for the CBC special on the Queen, the glasses had one eye which filtered out blue light and let through the red and green light and the other eye filtered out the red and green light and let only the blue light through.

In order to create a 3d image for these glasses we take two different images. From one image we take the blue channel and from the other image we take the red and green channel and we superimpose these two images on top of each other.



To make the 3d effect as pronounced as possible we may want to play a little with the intensities by scaling the red, green and blue channels since what has to happen is our brain pieces these two images together in such a way that we perceive a 3d image.



The result is that the queen ends up on CBC in 3d, all due to our ability to manipulate digital color values.