

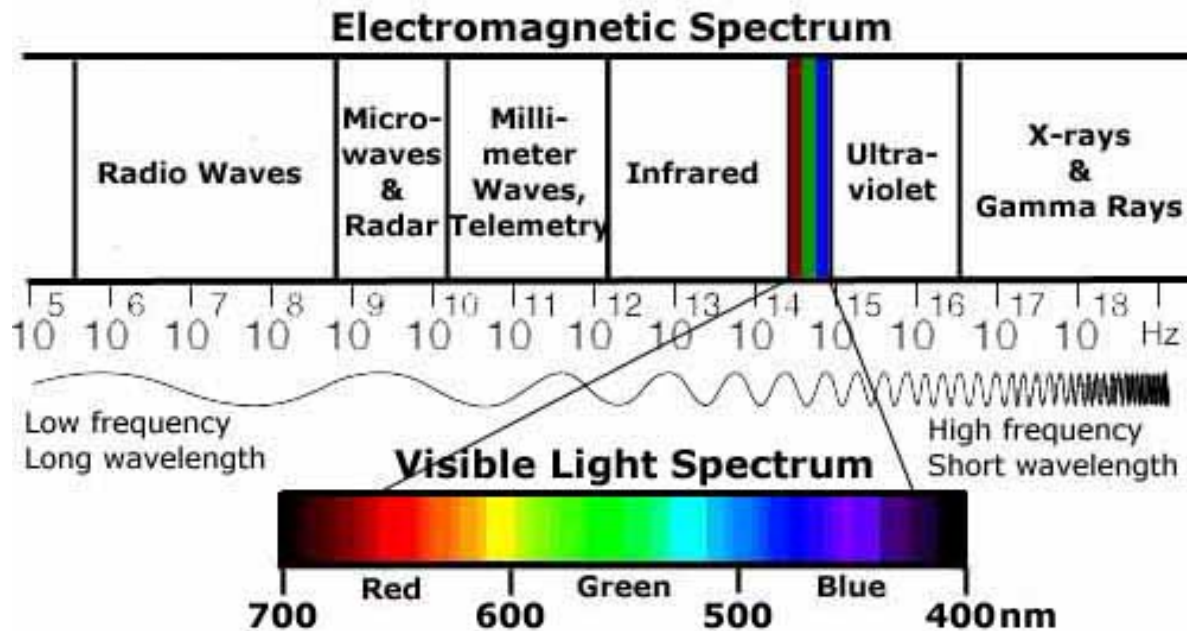
CSE 3200– Color Representation Models Unit 4

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Outline

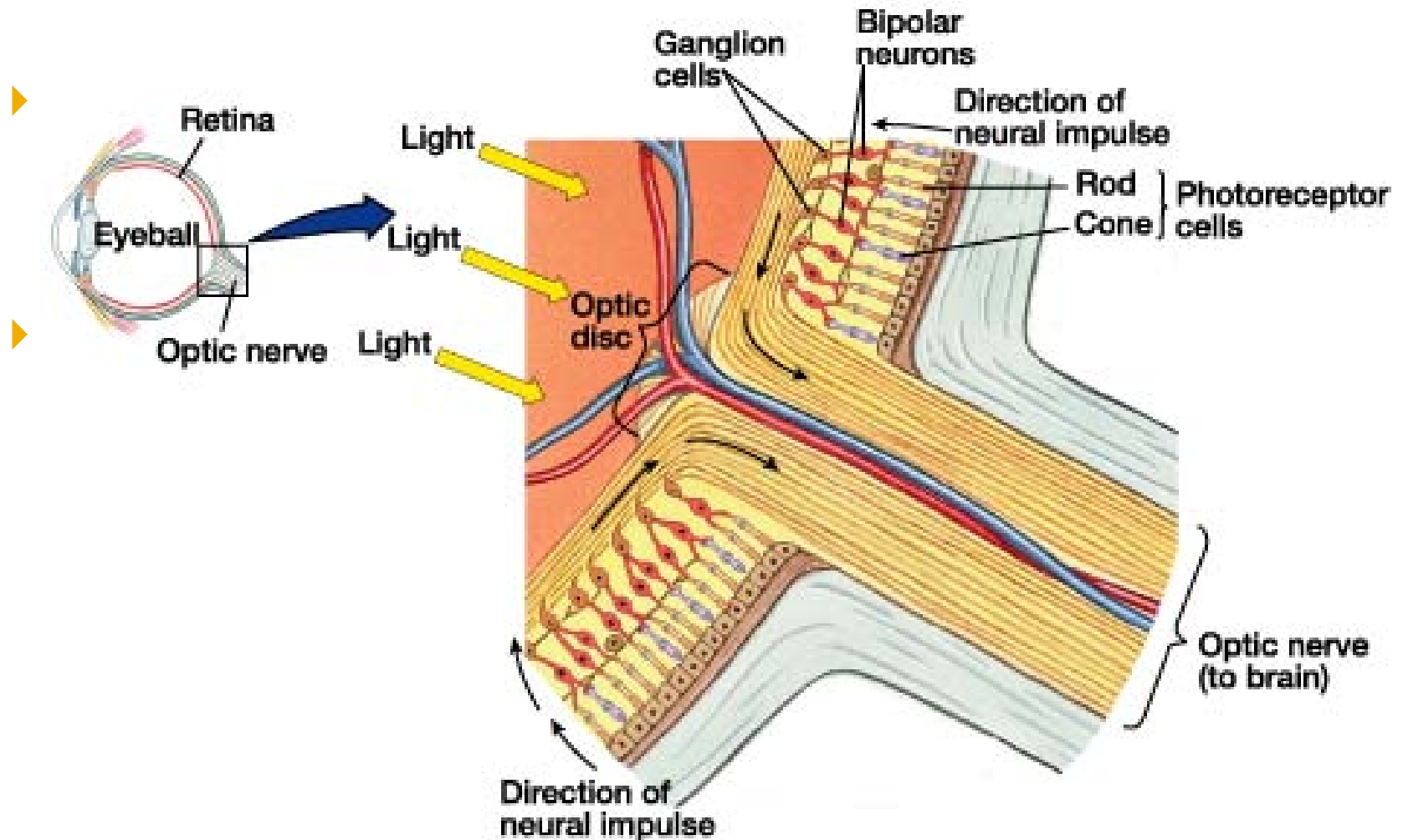
- ▶ What is color?
 - Electromagnetic Spectrum
 - Color is a sensation
 - Examination of the eye
- ▶ Additive & Subtractive Color Models
 - CYMK
 - RGB
- ▶ CG Color Models
 - Index Color Model
 - Representation
 - RGB Color Model
 - Representation
- ▶ Example Program
 - Basic Primitives
 - Aspect ratio
- ▶ Conclusion
- ▶ Questions
- ▶ Review Questions

What is color?



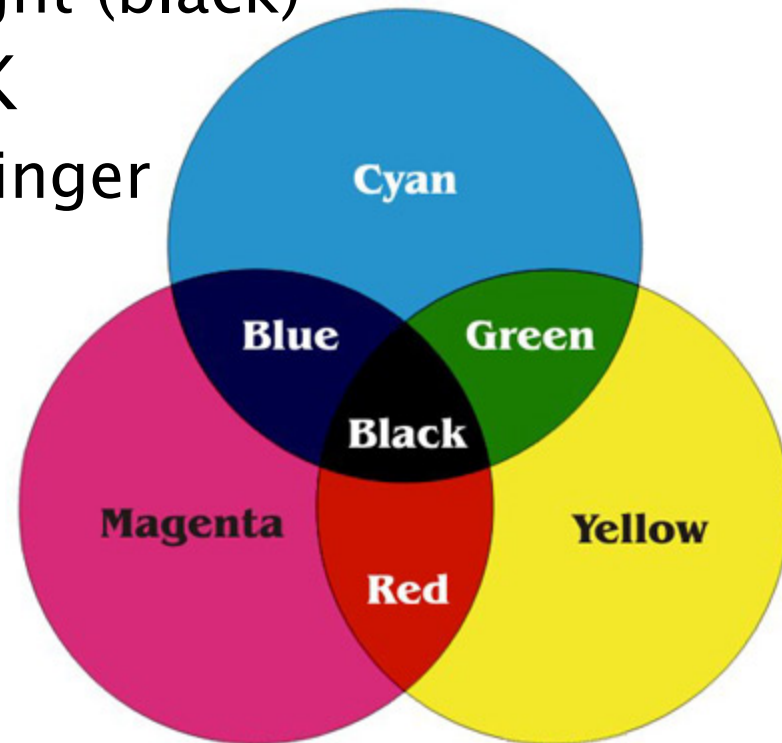
- ▶ Color is a perception... a **sensation** we get from processing visible light
- ▶ Visible light are made up of 7 groups – (the color of the rainbow)
 - Red, orange, yellow, green, blue, indigo, and violet

What is color? – Perception



Additive & Subtractive Colors

- ▶ What are surface colors?
 - Surface colors are as a result of pigments that either reflect all of the incoming light or absorb (subtract) some or all the light (black)
- ▶ Subtractive colors – CYMK
 - Used in the print industry, finger painting etc

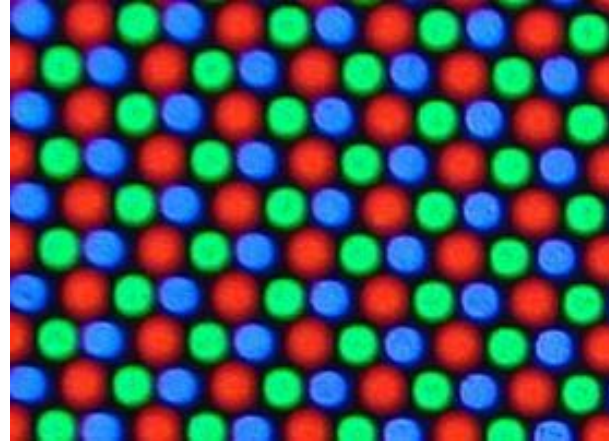


Additive Colors

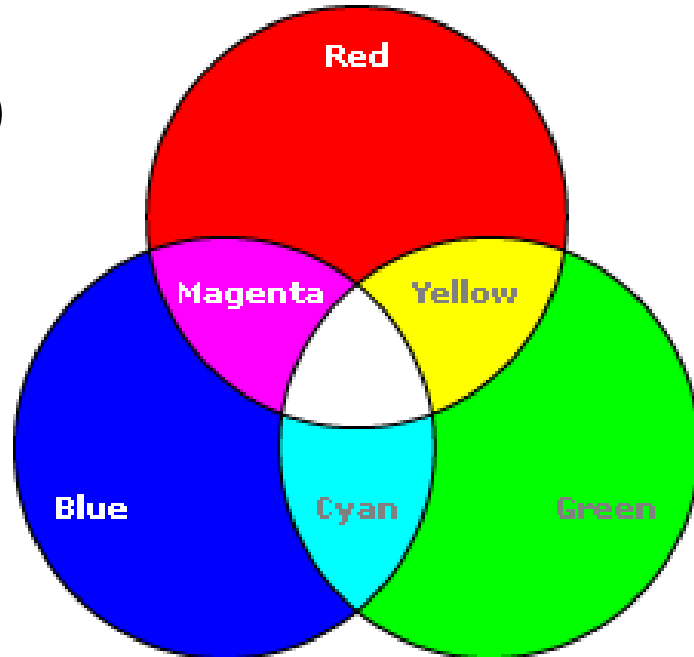
- ▶ Color Source
- ▶ Screens emit light, same light we interpret as colors
- ▶ Because of how our visual system works, we need process the colors of light.
 - No light = black (natural screen color)
 - Full intensity of all the colors = white
 - $Rf + Gf + Bf = \text{White}$
 - `glColor3f(1.0,0,0); //openGL set color`
 - Projected colors are additive (RGB)

Additive Colors – Con't

- ▶ CRT Screen



- ▶ Additive colors (RGB)

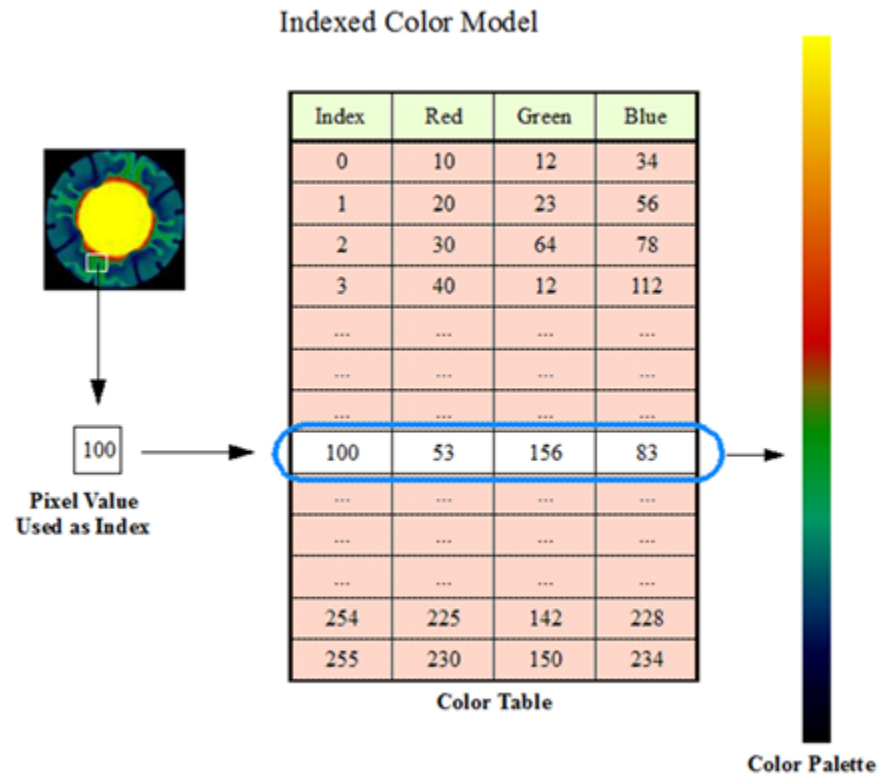


CG Color Models

▶ Index Color Model

- What is?
 - Analogous with an artist with a color palette
 - Large color palette
 - Limited number of brushes
- ▶ In CG we can argue that if we chose a limited number of colors from a large palette we should be able to create good quality images most of the time.
 - Suppose we have k bits per pixel then a pixel can be mapped to a value (index to a color in the palette) in a color-lookup table
 - Each pixel value is an integer between 0 and $2^k - 1$
- ▶ Index color model is popular with display systems with a low-depth frame buffer (not so long ago this was very common)

Index Color Model



CG Color models Con't

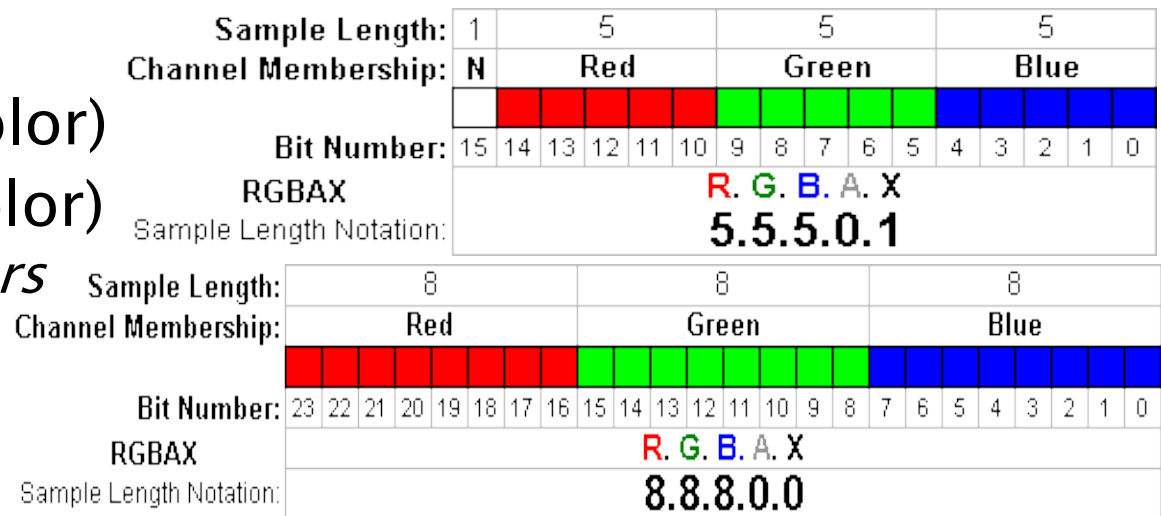
► RGB Color model

- Common format today
 - RED = glColor3f(1.0,0,0);
 - WHITE = ? , BLACK = ?

► Representation depends on the depth of the frame buffer

- 16 bits (Highcolor)
- 24 bits (Truecolor)

16.7 Million Colors

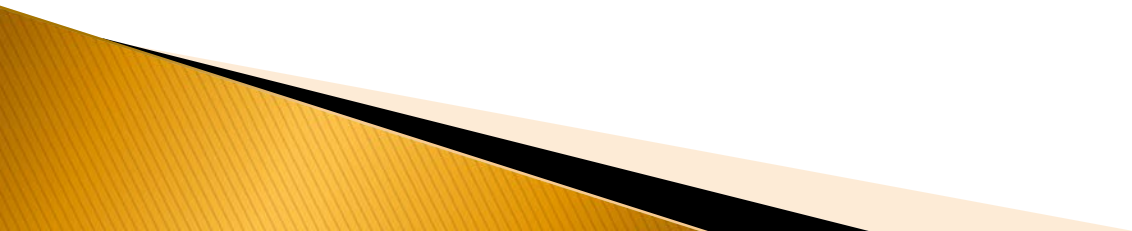


RGB Color Model

- ▶ RGB in CG is both a way of specifying color and a way of viewing color.
- ▶ Graphics algorithms manipulate RGB colors, and the images produced are encoded as RGB pixels
- ▶ displayed on devices that render these pixels by emitting RGB light

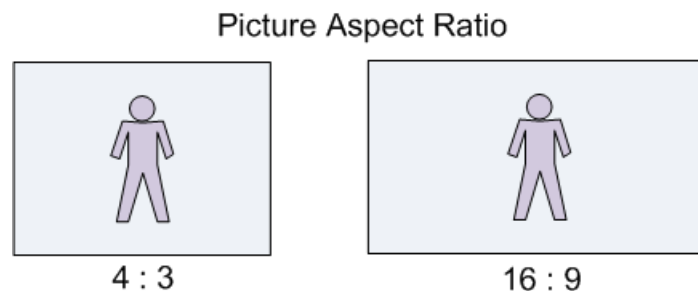
RGB Colors

	RGB				CMYK					HLS				HSV				Gray
	Red	Green	Blue		Cyan	Magenta	Yellow	Black		Hue, lightness, saturation				Hue, saturation, value				Value
Red	255	0	0		0	100	100	0		0	50	100		0	100	100		-
Orange	255	128	0		0	50	100	0		30	50	100		30	100	100		-
Yellow	255	255	0		0	0	100	0		60	50	100		60	100	100		-
Bright green	0	255	0		100	0	100	0		120	50	100		120	100	100		-
Cyan	0	255	255		100	0	0	0		180	50	100		180	100	100		-
Blue	0	0	255		100	100	0	0		240	50	100		240	100	100		-
Violet	128	0	255		50	100	0	0		270	50	100		270	100	100		-
Magenta	255	0	255		0	100	0	0		300	50	100		300	100	100		-
White	255	255	255		0	0	0	0		NA	100	NA		NA	0	100		0
Mid-gray	128	128	128		0	0	0	50		NA	50	NA		NA	0	50		50
Black	0	0	0		0	0	0	100		NA	0	NA		NA	NA	0		100



Aspect Ratio

- ▶ describes the proportional relationship between its width and its height
- ▶ commonly expressed as two numbers separated by a colon, as in 16:9 OR 4:3 ETC...



Aspect Ratio – Messed Up



Correct 4:3 Image on a 16:9 Screen




4:3 Image Stretched by TV to Fill Screen

Aspect Ratio Correction in OpenGL

- ▶ `void glutReshapeFunc(void (*func)(int width, int height));`
- ▶ `glutReshapeFunc` sets the reshape callback for the *current window*
- ▶ The reshape callback is triggered when a window is reshaped
- ▶ Demo

Conclusion

- ▶ Color is a by product of visual light
 - ▶ Color models vary on the basis of application
 - ▶ Index color mode is suitable for systems with low display memory (low depth framebuffer)
 - ▶ RGB color model is most popular and is a very convenient way of specifying colors
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Questions?

References

- ▶ Index Color Model: Angel, Edward. Interactive Computer Graphics: A Top-down Approach with OpenGL/Edward Angel. 2nd Ed.
- ▶ Images:
 - Eye:
<http://www.astro.virginia.edu/class/oconnell/astr1230/im/human-eye-crossec.jpg>
 - RGB Color Models:
http://en.wikipedia.org/wiki/RGB_color_model