EECS 3431
Intro to 3D Computer Graphics

Content

This course introduces the fundamental concepts and algorithms of three-dimensional computer graphics. Topics include: an overview of graphics hardware, graphics systems and APIs, object modelling, transformations, camera models and viewing, visibility, illumination and reflectance models, texture mapping and an introduction to advanced rendering techniques such as ray tracing. Optional topics include an introduction to animation, visualization, or real-time rendering.

Prerequisites: General prerequisites; EECS2031 3.00, MATH1025 3.00

Learning Outcomes

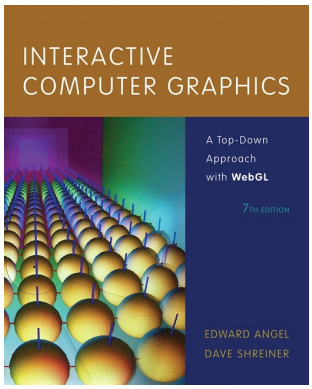
After successful completion of the course, students are expected to be able to:

- Explain the basic stages and concepts of a modern graphics pipeline
- Model a virtual scene using geometric primitives and affine transformations
- Model basic materials and their interaction with virtual light sources
- Explain basic concepts related to colour spaces and visual perception
- Explain basic concepts related to global illumination
- Produce rendered images of virtual scene from a corresponding scene description file

Course Details

- www.eecs.yorku.ca/course/3431
- WF 11-12:30, DB 0007
- 4 assignments, midterm, final
- WebGL, Javascript, C

Recommended Textbook



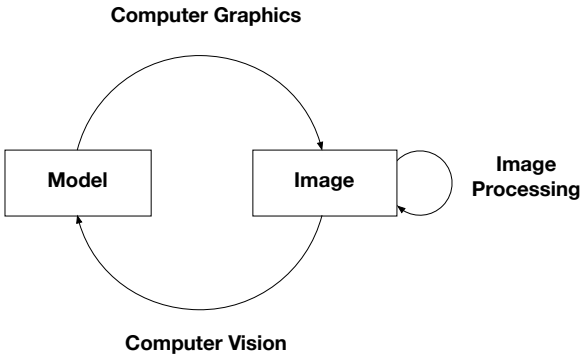
Course Evaluation

Work	Date	Weight
A1	Sept 27	3%
A2	Oct 18	9%
Midterm	Oct 25	25%
A3	Nov 15	9%
A4	Dec 1	9%
Exam	?	45%

About Me

- John Amanatides
- amana@yorku.ca
- Office hours: W12:30-3:30, BC 207D

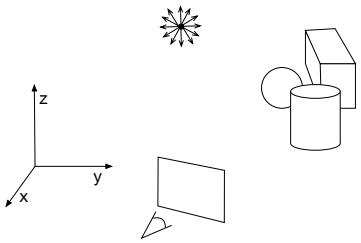
What is CG?



Applications

- Display of information
- Design
- Games
- Simulation
- Animation
- User interfaces

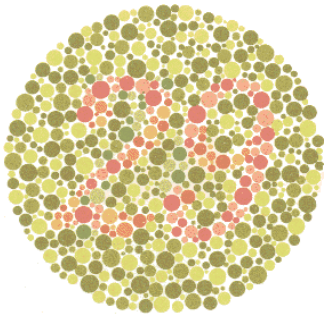
The Fundamental Problem



Given: model, material properties, eye/camera, lights

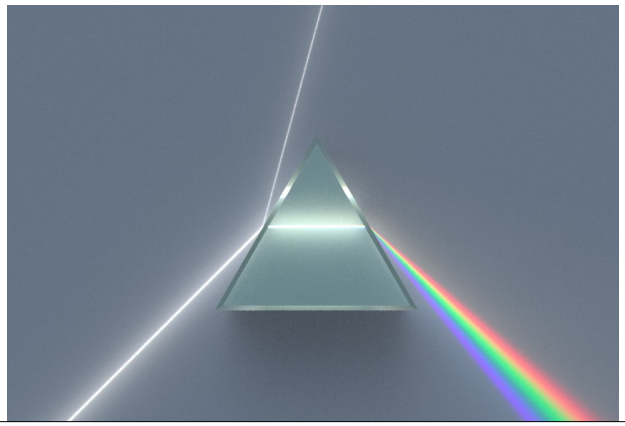
Generate 2-D image

Color Perception



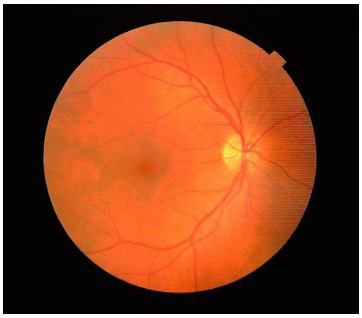
colorvisiontesting.com

White light isn't white

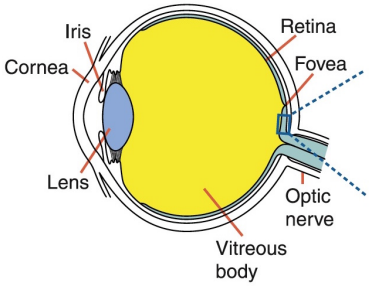


Wikimedia

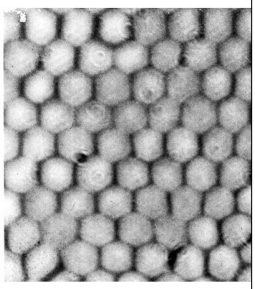
The Eye



The Eye



Foveal cone mosaic

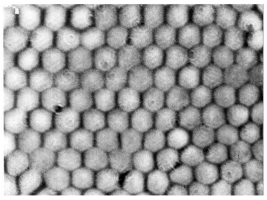


amkrosnar.wordpress.com

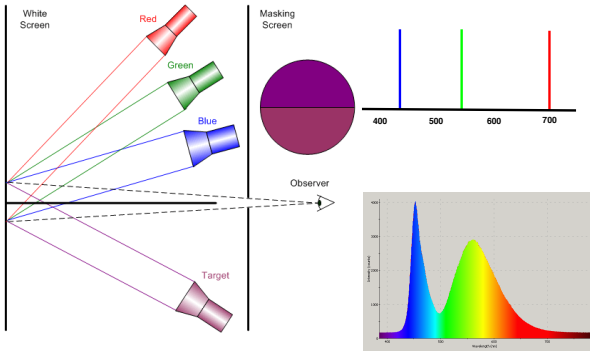
David Heeger

How many colors can we detect?

Foveal cone mosaic

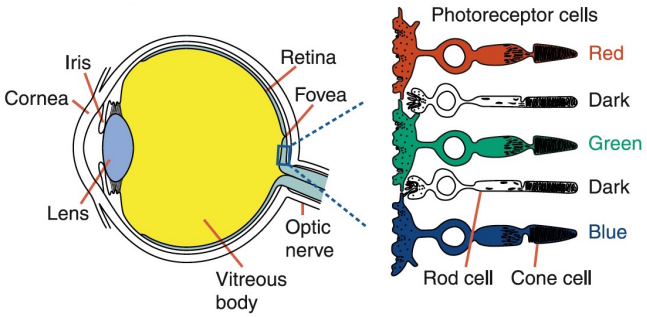


19th Century Experiments



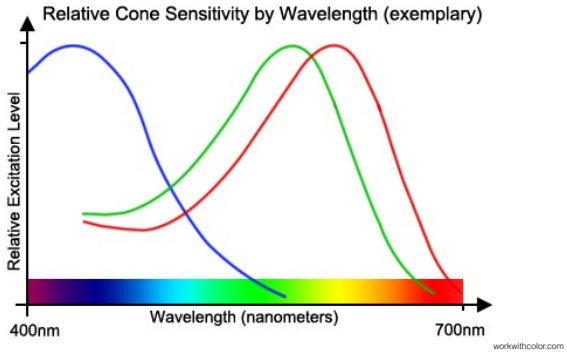
betterphotographyfutorials.com

3 Color Sensors (Cones)



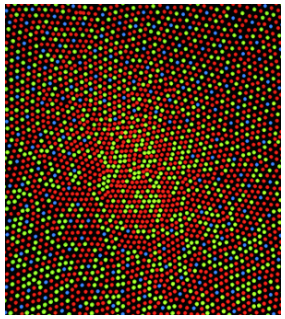
amkrosnar.wordpress.com

How Cones See Spectrum

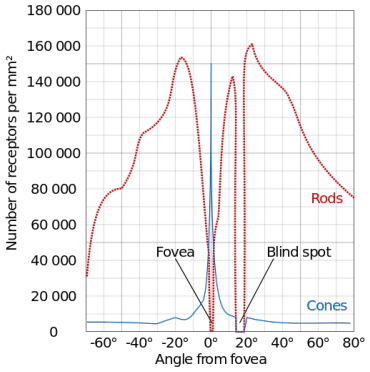


workwithcolor.com

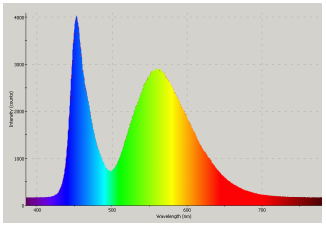
Cone Distribution

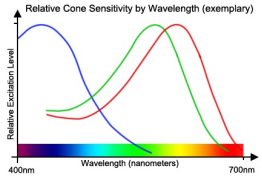


Wikipedia



Seeing Colors



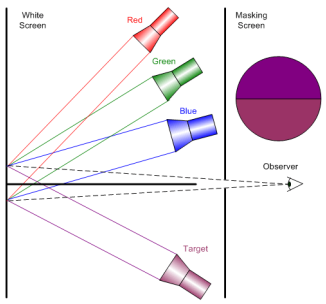


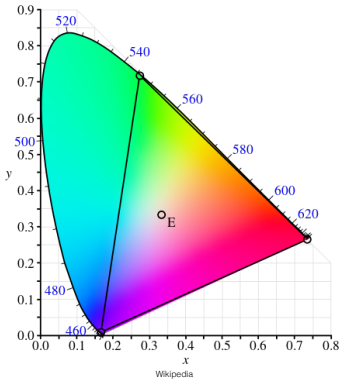
$$R = \int_{400}^{700} Intensity(\lambda) \cdot ConeSensitivity_R(\lambda)$$

$$G = \int_{400}^{700} Intensity(\lambda) \cdot ConeSensitivity_G(\lambda)$$

$$B = \int_{400}^{700} Intensity(\lambda) \cdot ConeSensitivity_B(\lambda)$$

Mixing Lights

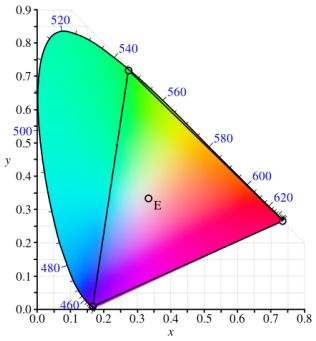


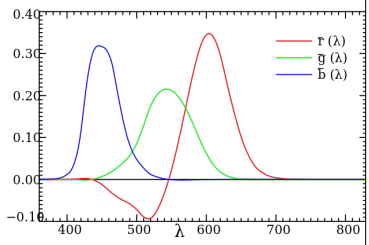


Wikipedia

CIE RGB Primaries

1931

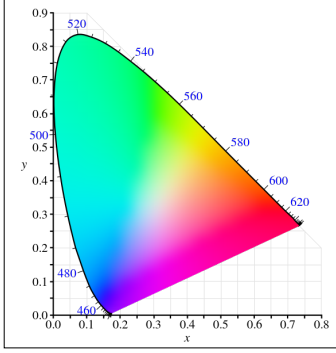


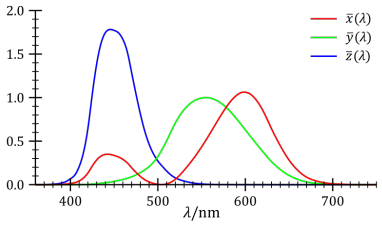


Wikipedia

CIE XYZ Primaries

1931

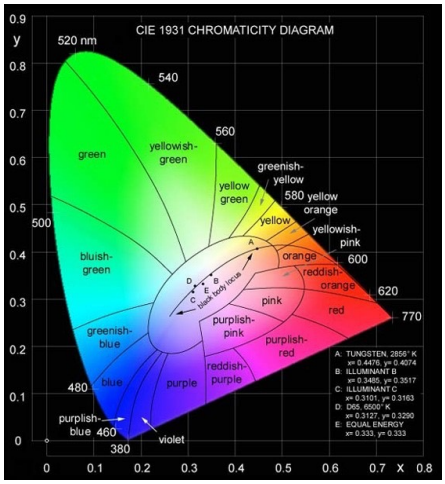




$$x = \frac{\bar{x}}{\bar{x} + \bar{y} + \bar{z}}$$

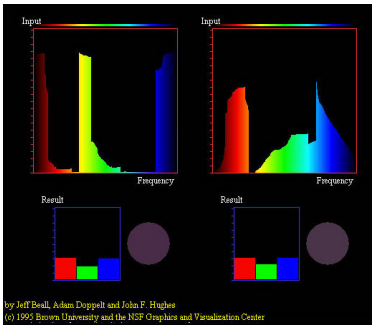
$$y = \frac{\bar{y}}{\bar{x} + \bar{y} + \bar{z}}$$

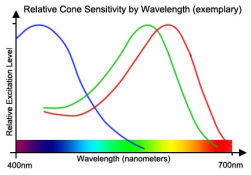
Wikipedia



Wikipedia

Metamers





Mixing Colors

howwemvontessori.com

What are the primary colors?

craftychild.com

What are the primary colors?

What are the primary colors?

What are the primary colors?

What are the primary colors?

pinterest.com

What are the primary colors?

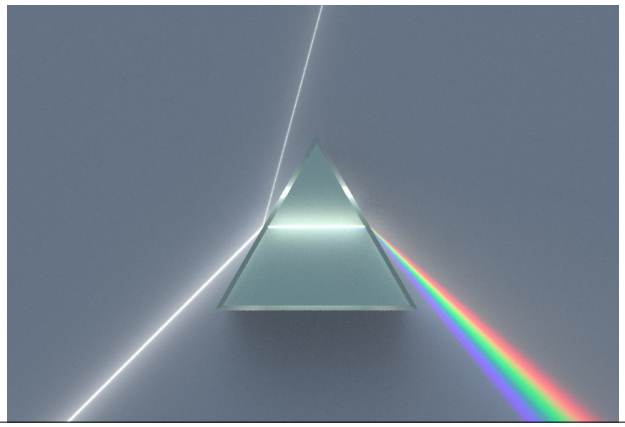
ajkerdeal.com

Why different primaries?

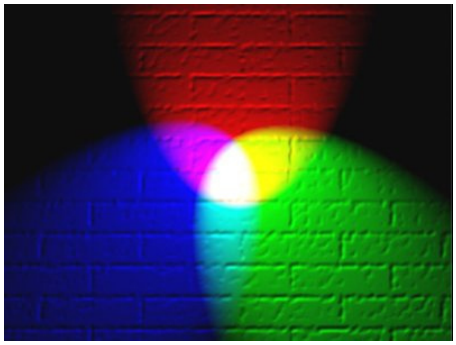
- Red, Green, Yellow, Blue
- Cyan, Magenta, Yellow
- Cyan Magenta, Yellow, Black
- Red Green Blue

additive vs subtractive primaries

White light isn't white

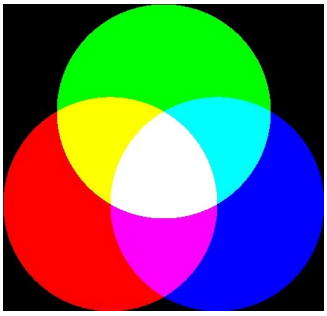


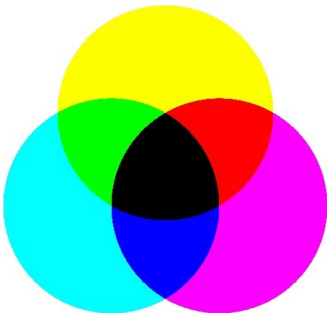
Additive primaries



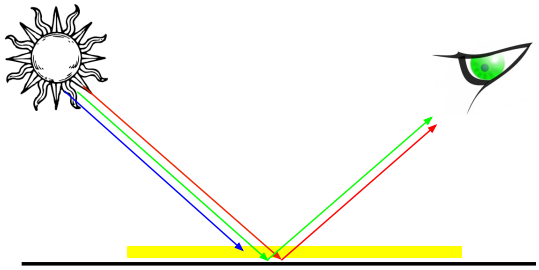
Wikipedia

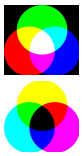
Additive vs Subtractive



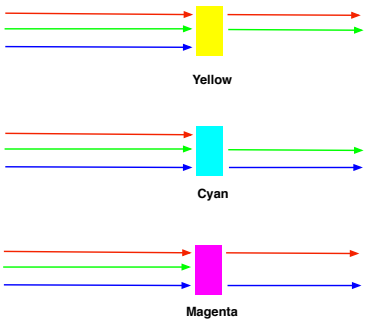


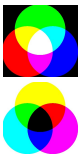
Ink Absorbs



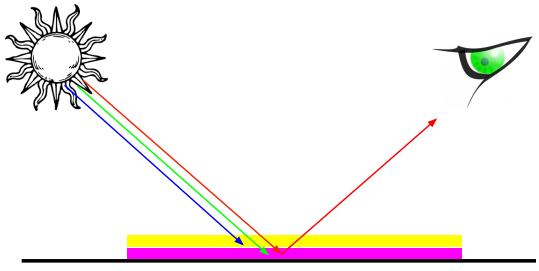


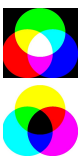
Subtractive primaries remove one additive primary at a time





Getting Red

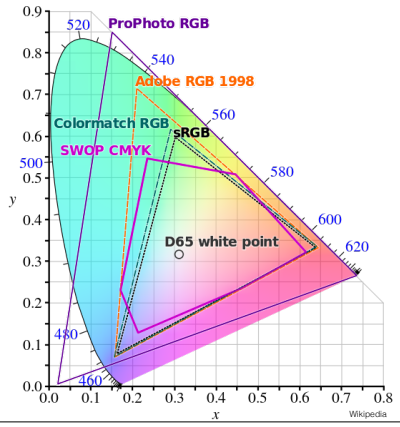




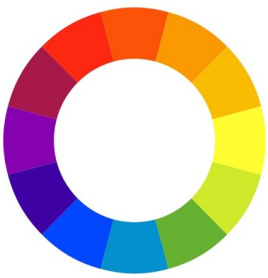
Color Spaces

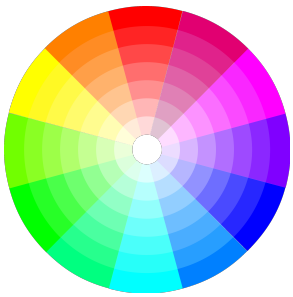
- RGB various flavours
- CIE XYZ
- CMY
- CMYK
- HSV
- etc

Variations of RGB

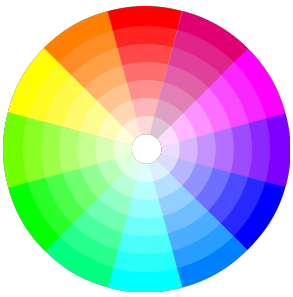


Painters use Color Wheels



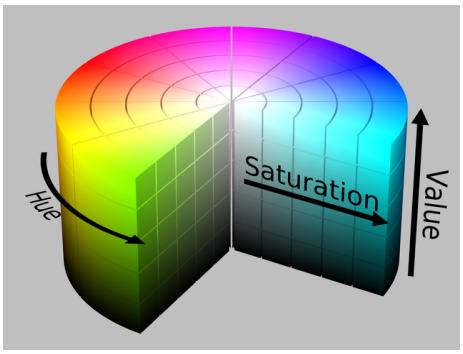


Hue and Saturation



Weller Publishing

HSV



Wikipedia