# Computer Graphics

LECTURE 03

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# Last Class Overview

- Introduction to Computer Graphics (Cont.)
  - Visualization
  - Image Processing
  - Graphical User Interfaces (GUI)
- Overview of Graphics Systems
  - Display Devices

# Today's Agenda

- Overview of Graphics Systems
  - Display Devices
    - Colors and colored displays
    - Raster displays and frame buffer

# CRT

- Filament (acts as heating element, electrons emit from it in the form of beam)
- Electrons move towards  positive plate (Anode) focusing cylinder (Electric field)
- Vertical and horizontal deflection plates have magnetic field in between them and control the position of the electron beam.
- Beam strikes phosphor coating on front of tube producing illumination.
  - Stronger the beam, brighter is the screen
  - Longer the beam stays on a point brighter is the screen

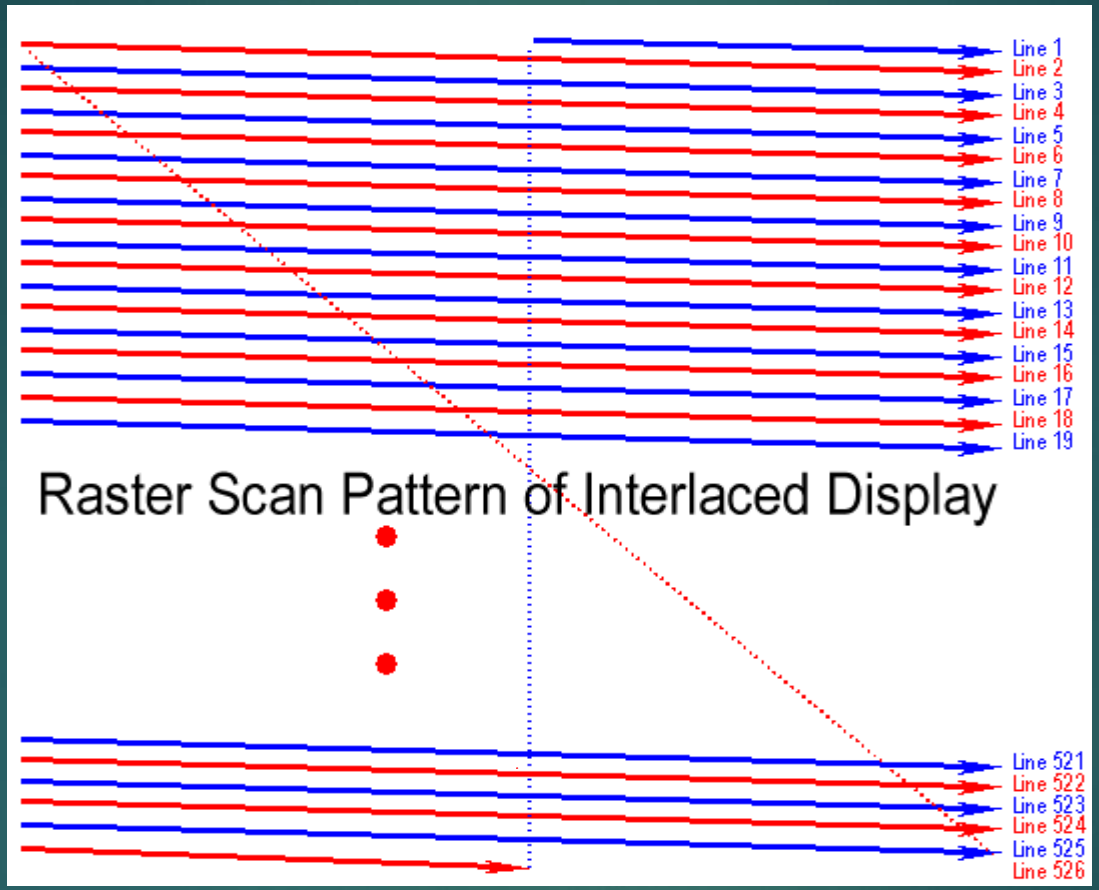
# Characteristics of CRT

- It's massive evacuated glass tube
- Capabilities of CRT are measured by
  - Size of tube
  - Brightness of the phosphors vs. darkness of the tube
  - Speed of electron gun
  - Diameter of the beam
  - Pixels
- Disadvantages are
  - Size of the tube
  - High power consumption
  - Flicker
  - Costly to refresh

# Characteristics of CRT (Phosphors)

- Florescence is Light emitted while the phosphor is being struck by electrons
- Phosphorescence is Light emitted once the electron beam is removed
- Persistence: The time from the removal of the excitation to the moment when phosphorescence has decayed to 10% of the initial light output

# Interlacing



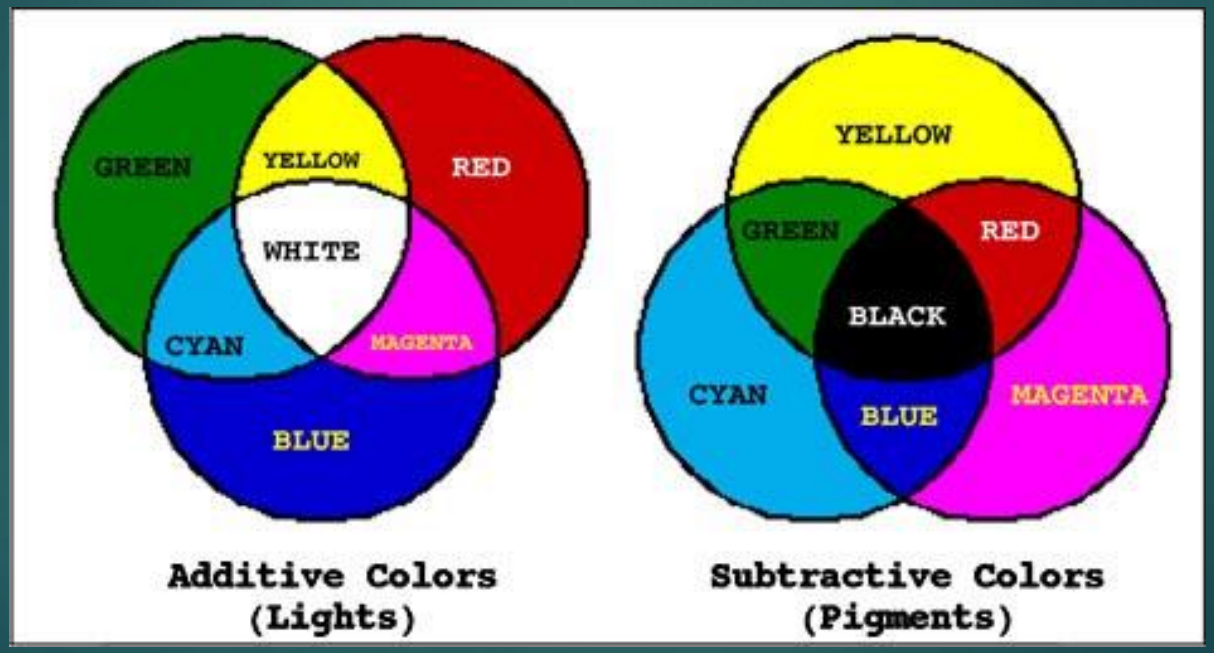

http://escience.anu.edu.au/lecture/cg/Display/raster.en.html

# Video Formats

- NTSC - 525x480, 30f/s, interlaced
- PAL - 625x480, 25f/s, interlaced
- VGA - 640x480, 60f/s, non-interlaced
- SVGA – 800x600, 60f/s non-interlaced
- RGB - 3 independent video signals and synchronization signal, vary in resolution and refresh rate
- Time-multiplexed color - R,G,B one after another on a single signal, vary in resolution and refresh rate

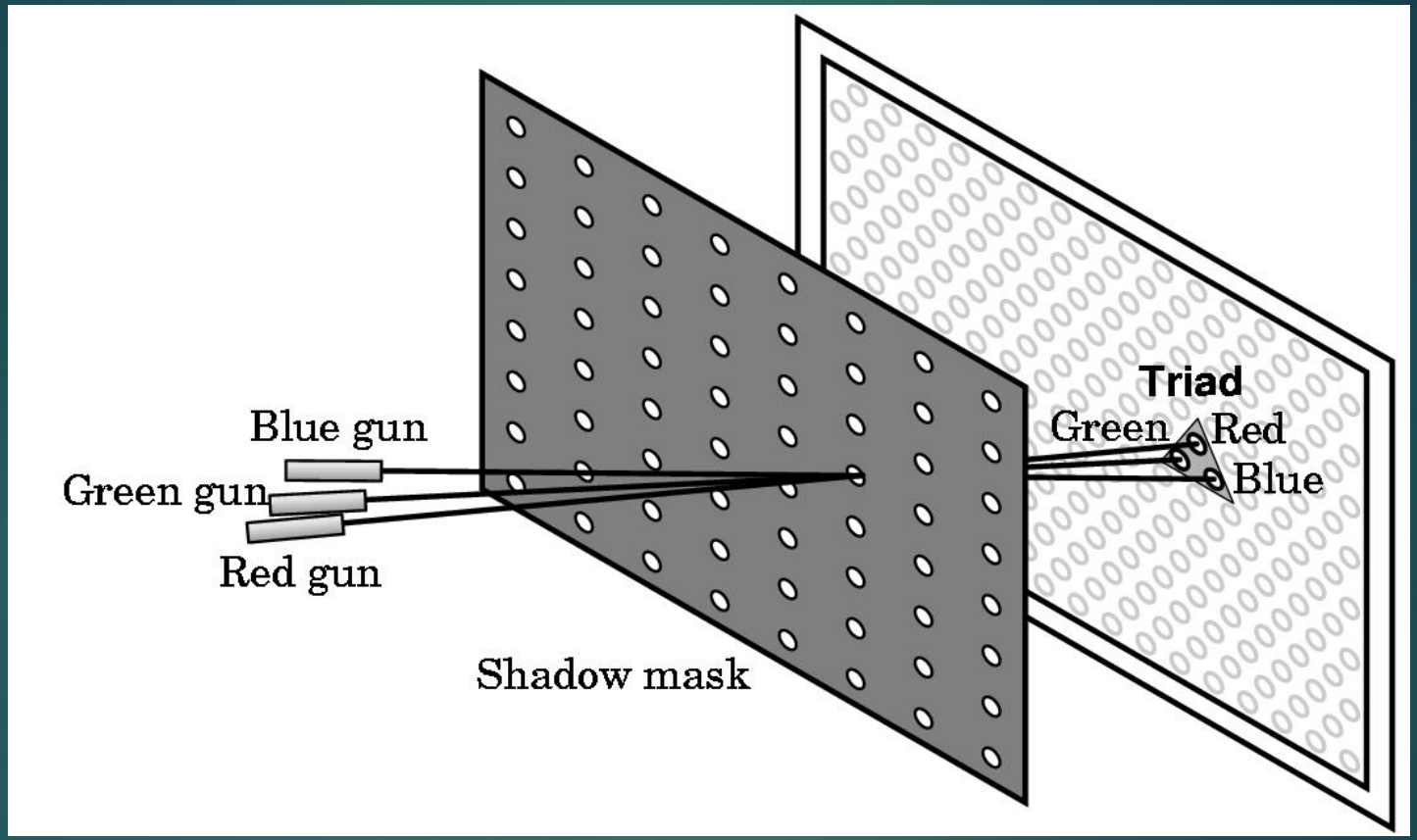
# Colors

- Additive Colors
  - Red Green and Blue (sometimes White)
- Subtractive Colors
  - Yellow Cyan Magenta and Black




http://www.d.umn.edu/~mharvey/th1501color.html

# Color Display



# Raster Displays

- Use sequential access
  - Raster Displays (early 70s)
    - like television, scan all pixels in regular pattern
    - use frame buffer (video RAM) to eliminate sync problems
  - RAM
    - ¼ MB (256 KB) cost $2 million in 1971

# Frame Buffer

- Raster images require frame buffers
- **Frame buffer** - A block of memory, dedicated to graphics output, that holds the contents of what will be displayed.
- If we want a frame buffer of 640 pixels by 480 pixels, we should allocate:

  frame buffer = 640*480 bits

- How many colors does 1 bit get you?
- How many colors do 8 bits get you?
  - Monochrome systems use this (green/gray scale)
- What bit depth would you want for your frame buffer?

# Frame Buffer

- No. of bytes in a frame buffer = 640*480*3
- This way we can calculate memory of graphics card

# Summary

- Overview of Graphics Systems
  - Display Devices
    - Colors and colored displays
    - Raster displays and frame buffer

# References


- Fundamentals of Computer Graphics Third Edition by Peter Shirley and Steve Marschner
- Interactive Computer Graphics, A Top-down Approach with OpenGL (Third Edition) by Edward Angel.