Displays

CMSC 435/634
Light

• Visible Range: 390-700nm
• Luminance has large dynamic range
  – 0.00003 Moonless overcast night sky
  – 30. Sky on overcast day
  – 30000. Sky on clear day
  – 16,000. Snowy ground in full sunlight
• Actual colors result from spectral curves
  – dominant wavelength, hue
  – brightness, lightness
  – purity, saturation
Physiology

• Rods
  – active at low light levels (scotopic vision)
  – only one wavelength sensitivity function

• Cones
  – active at normal light levels
  – three types: sensitivity functions with different peaks
Spectral Sensitivity

![Graph showing spectral sensitivity of different types of cones: S-cones, M-cones, and L-cones. The graph plots sensitivity on the y-axis against wavelength (nanometers) on the x-axis. S-cones peak at around 400 nm, M-cones at around 500 nm, and L-cones at around 600 nm.]
Additive Color Mixing

![Diagram of additive color mixing with RGB axes and color points](image)
Gamut
Random/Vector Display
Examples of Random Scan
Examples of Random Scan
Examples of Random Scan
Raster Display
Raster Display

• Each left-to-right trace is called a scan line
• Each spot on the screen is called a pixel
• Beam turned off to swipe back and up screen  
  – Called a retrace or blanking interval
Vector vs. Raster

(a) Ideal line drawing
(b) Random scan
(c) Raster scan with outline primitives
(d) Raster scan with filled primitives
Color CRT

1) Electron guns
2) Electron beams
3) Focusing coils
4) Deflection coils
5) Anode connection
6) Shadow mask
7) Phosphor with RGB zones
8) Phosphor / Mask close-up
Color CRT

- Uses triads of red, green & blue at each pixel
- Uses 3 electron guns - one for each color
- Shadow mask used to make each kind of phosphor only visible from one gun
Liquid Crystal Display (LCD)

- Light enters polarizer
- Nematic crystals twist based on voltage
- Allowing light to pass through to other polarizer
Color LCD
Light Emitting Diode

789
Gamma

correction
1/2.2

CRT
gamma
2.2
Gamma Correction