Perceptual Color Spaces

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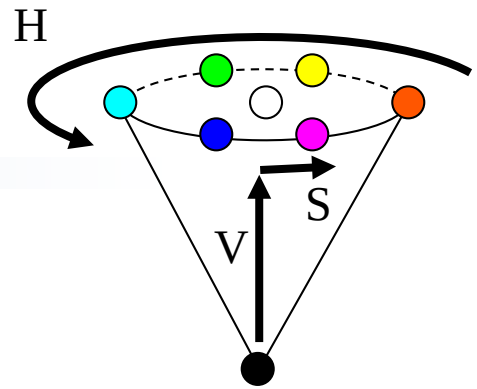
CS 418

Interactive Computer Graphics

Selecting Colors



HSV = Hue, Saturation, Value

- 1978, Alvy Ray Smith
- Hue [0,360] is angle about color wheel

  0° = red, 60° = yellow, 120° = green,

  180° = cyan, 240° = blue, 300° = magenta
- Saturation [0,1] is distance from gray

  S = (maxRGB – minRGB)/maxRGB
- Value [0,1] is distance from black

  V = maxRGB

Δ = maxRGB – minRGB

maxRGB = R → H = (G – B)/Δ

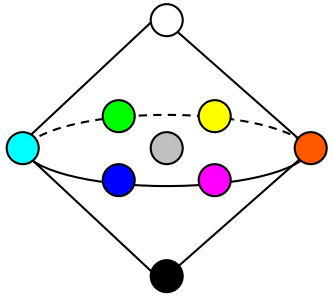
maxRGB = G → H = 2+(B – R)/Δ

maxRGB = B → H =4+ (R – G)/Δ

H = (60*H) mod 360

HLS = Hue, Saturation, Lightness

- Double cone, saturation in middle

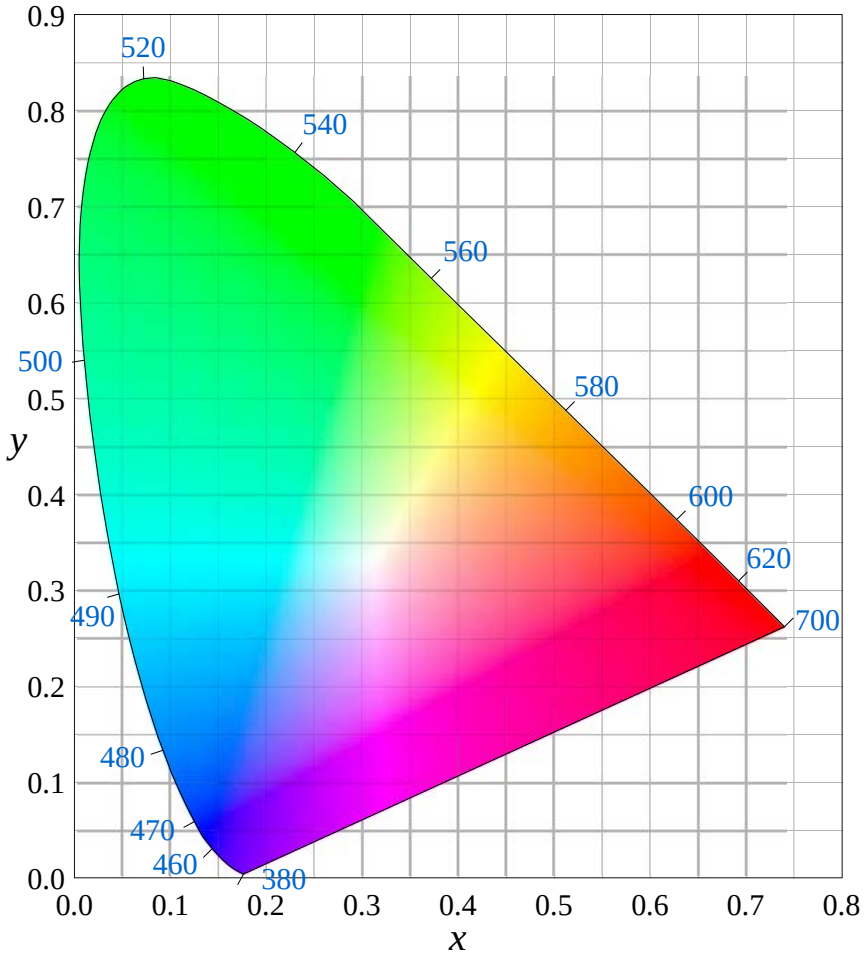


CIE XYZ

- CIE: International Commission on Illumination
- 3-D space defined by three color-matching functions
  - $X \cong R$, $Y \cong G$, $Z \cong B$
  - Y indicates brightness
- Projected to 2-D using

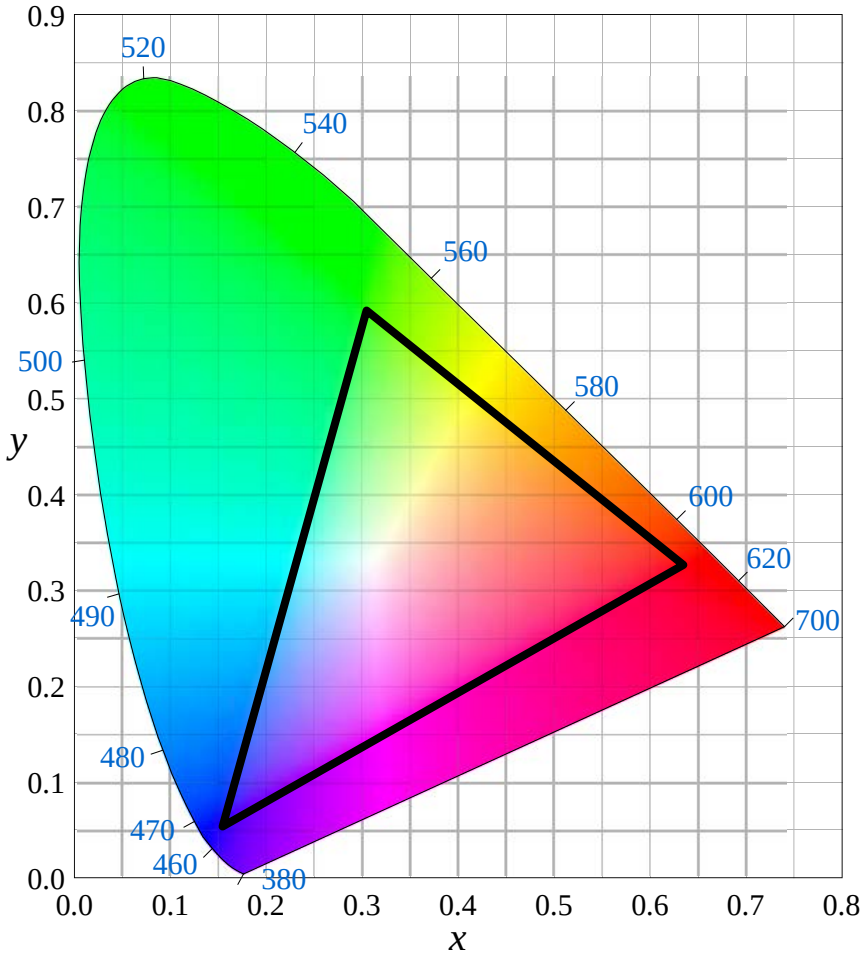
  $x = X/(X + Y + Z)$

  $y = Y/(X + Y + Z)$
- Perceptually designed
- L,a*,b* space measures perceptual distance between colors

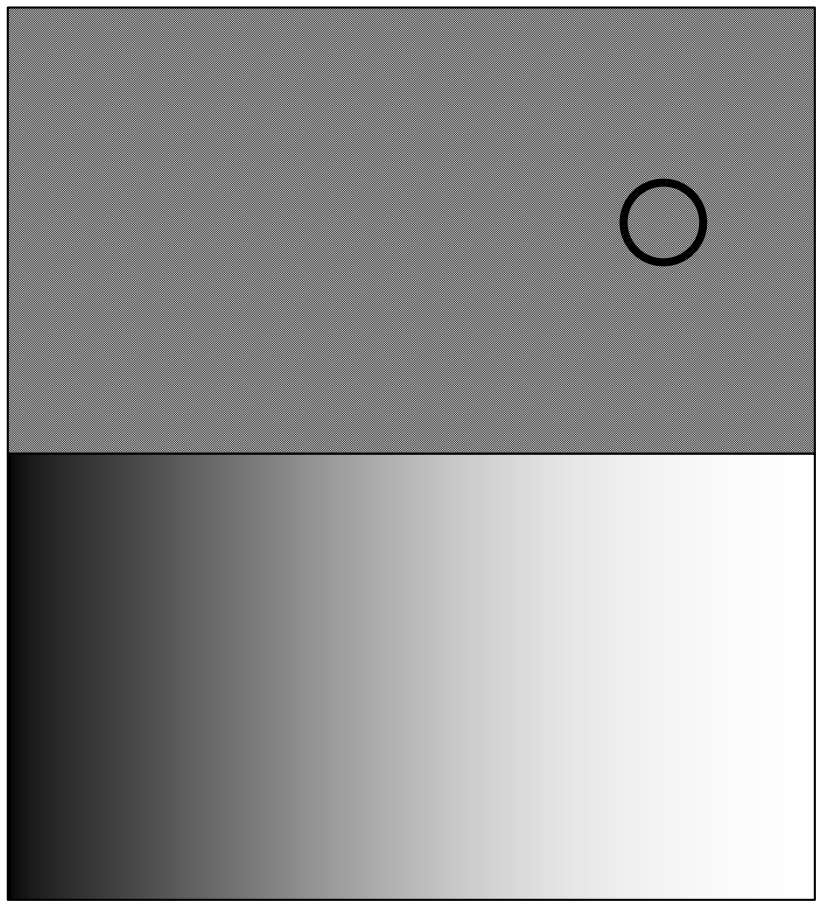


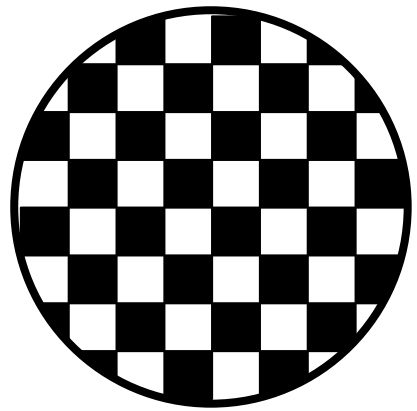
Gamut

- Portion of the spectrum reproduced by a given color space
- TV’s (even HDTV’s) can only display a small portion of perceivable colors
- Printers can display a slightly different portion of colors



Gamma





Gamma

- We perceive differences in intensity more carefully for darker shades
- Monitors accommodate this feature

$$I = cV^{\gamma}$$

- Gamma usually between 2 and 2.5
- Need to correct pixel values so they display correct intensity

$$\log I = \log c + \gamma \log V$$