

Perceptual Color Spaces

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CS 418

Interactive Computer Graphics

Selecting Colors

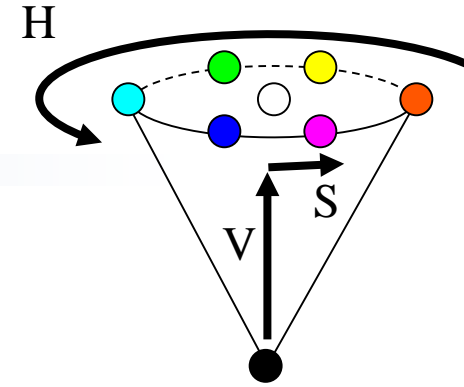
HSV = Hue, Saturation, Value

- 1978, Alvy Ray Smith
- Hue [0,360] is angle about color wheel
 $0^\circ = \text{red}$, $60^\circ = \text{yellow}$, $120^\circ = \text{green}$,
 $180^\circ = \text{cyan}$, $240^\circ = \text{blue}$, $300^\circ = \text{magenta}$
- Saturation [0,1] is distance from gray
 $S = (\text{maxRGB} - \text{minRGB}) / \text{maxRGB}$
- Value [0,1] is distance from black

$$V = \text{maxRGB}$$

HLS = Hue, Saturation, Lightness

- Double cone, saturation in middle



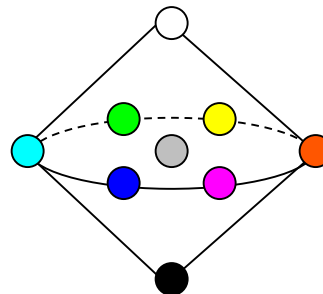
$$\Delta = \text{maxRGB} - \text{minRGB}$$

$$\text{maxRGB} = R \rightarrow H = (G - B) / \Delta$$

$$\text{maxRGB} = G \rightarrow H = 2 + (B - R) / \Delta$$

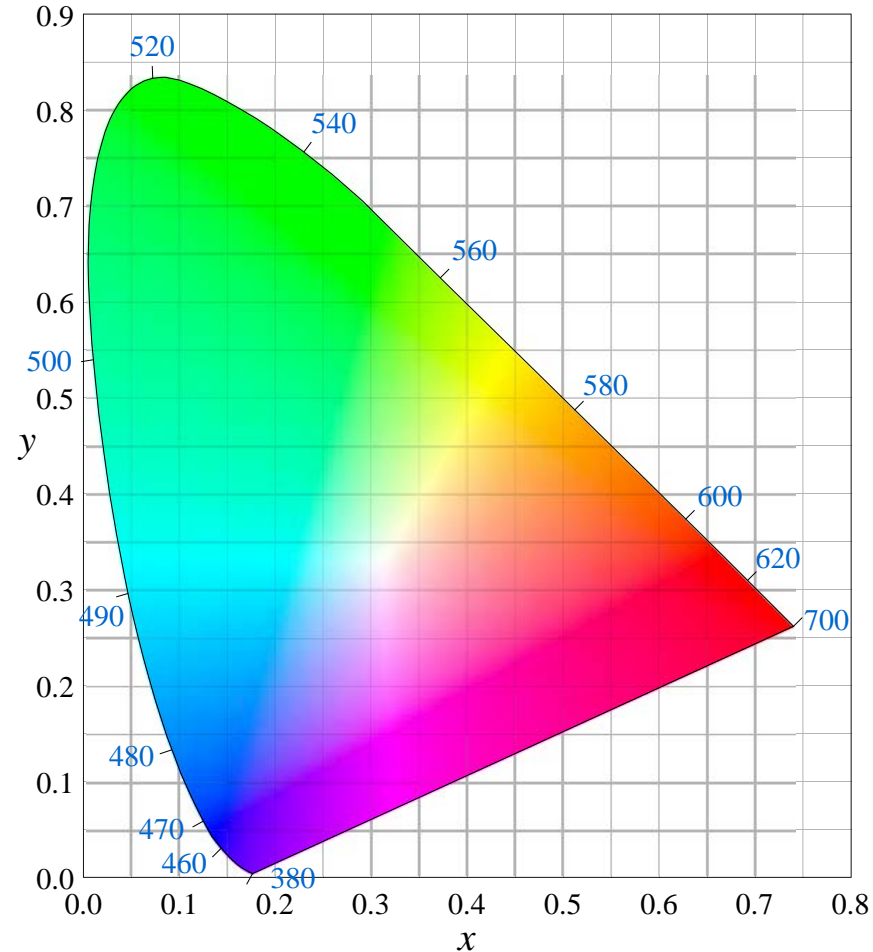
$$\text{maxRGB} = B \rightarrow H = 4 + (R - G) / \Delta$$

$$H = (60 * H) \bmod 360$$



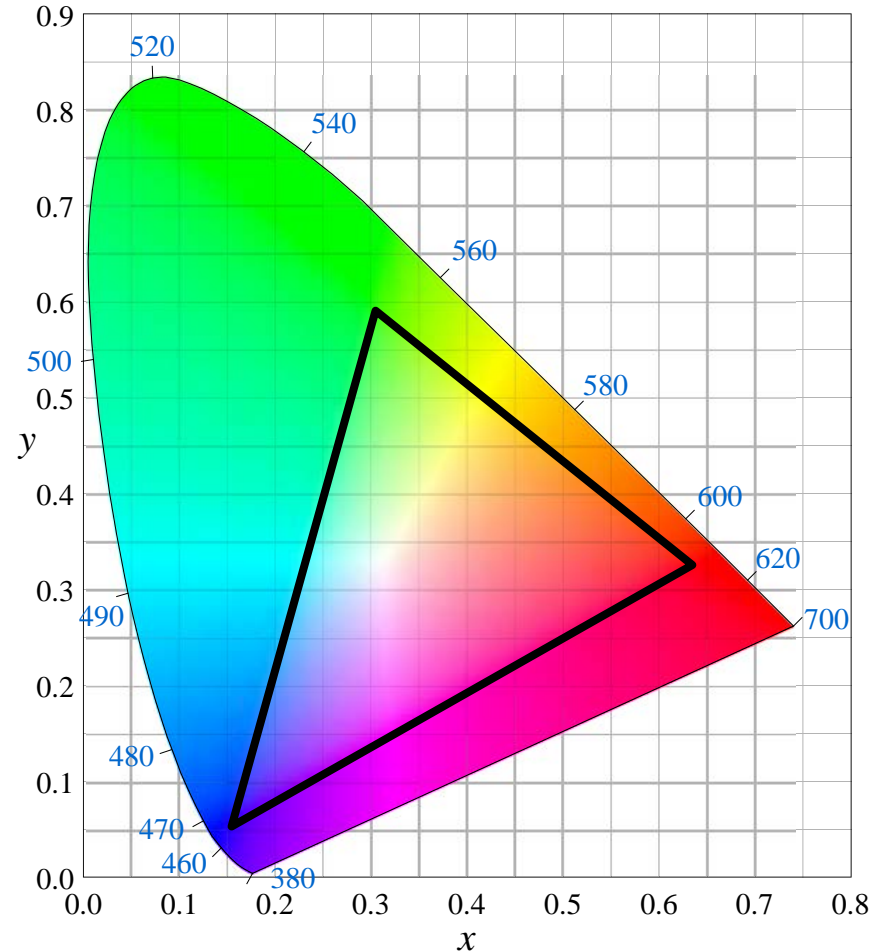
CIE XYZ

- 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

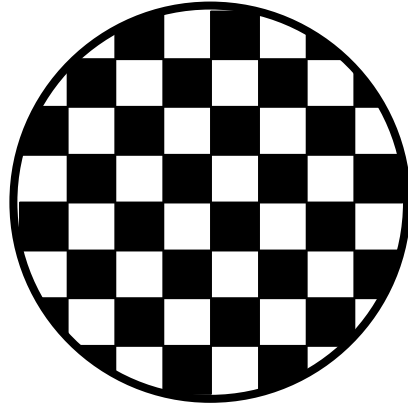
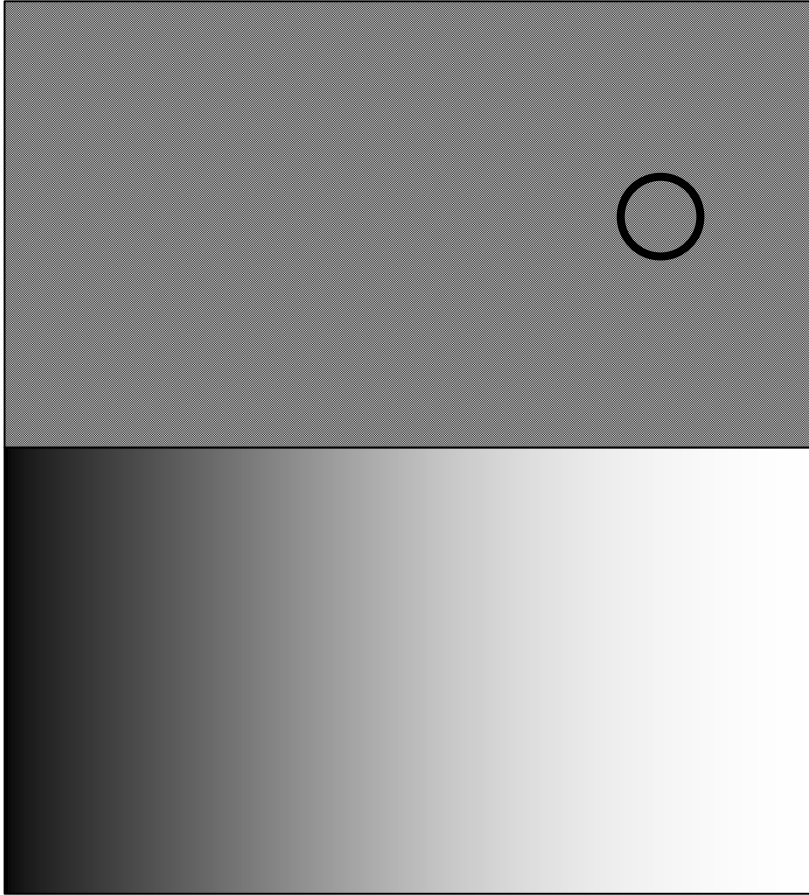


Gamut

- 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

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

