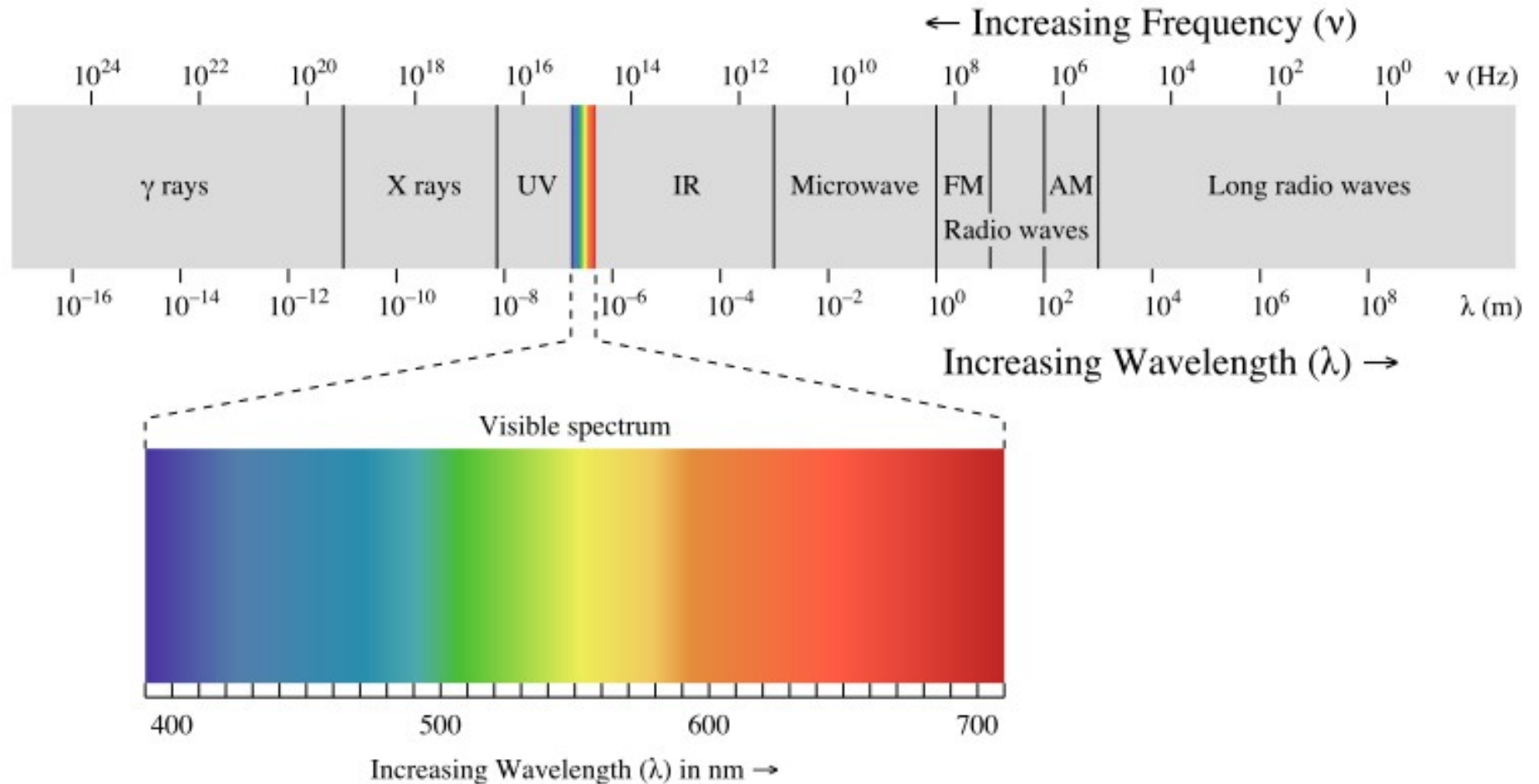


CompSci 372 – Tutorial

Part 10

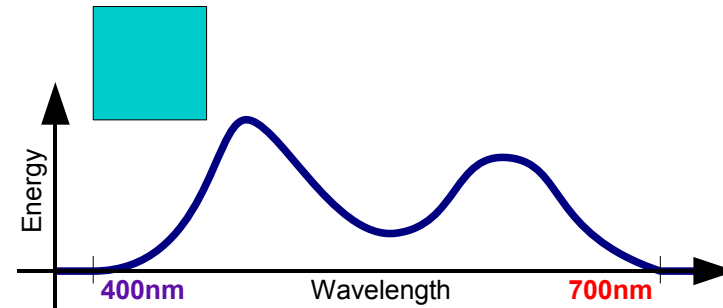
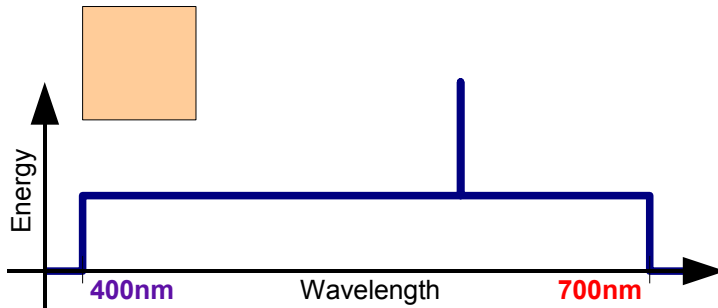
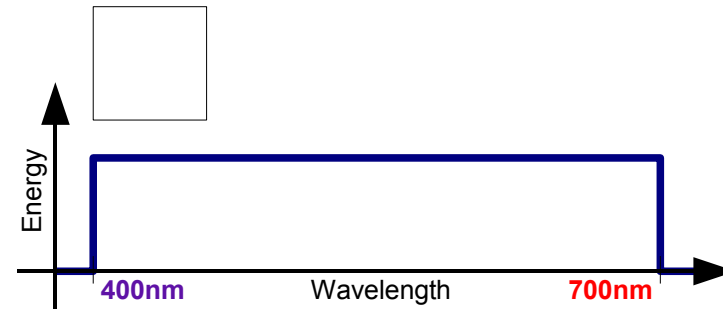
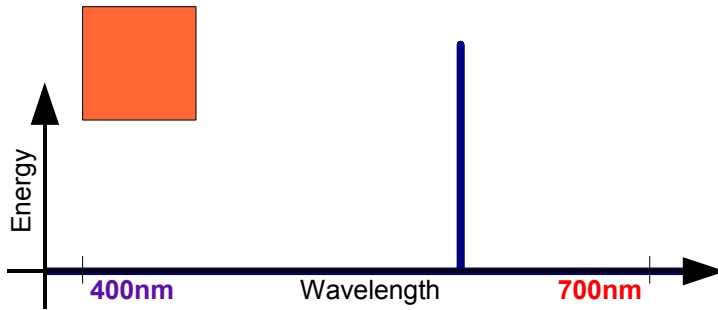
Colour

Electromagnetic Radiation

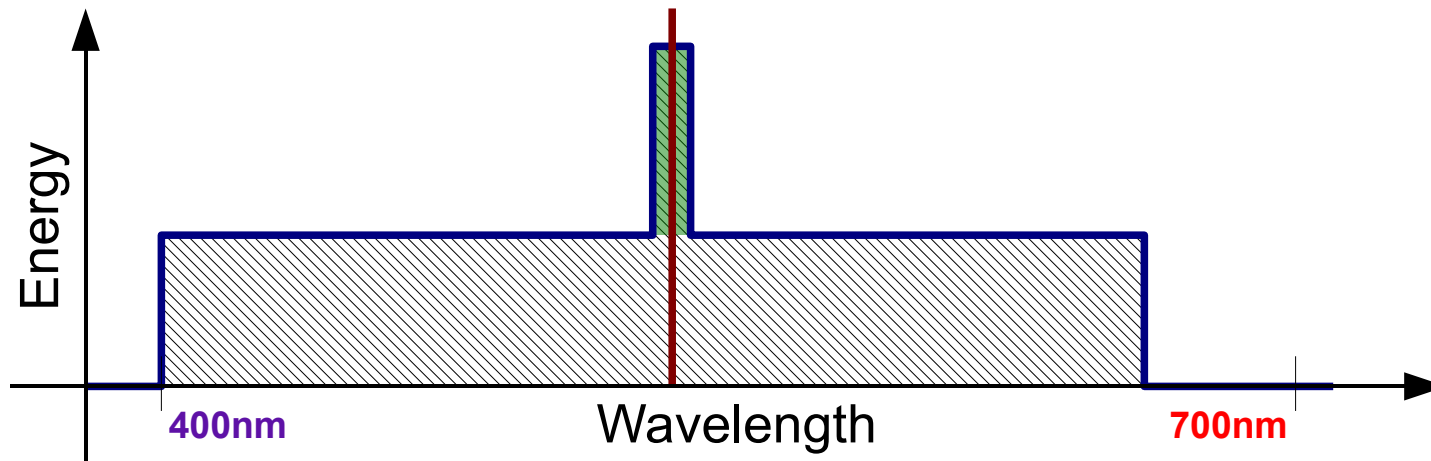


Spectrum

- Spectral Density Function (SDF)

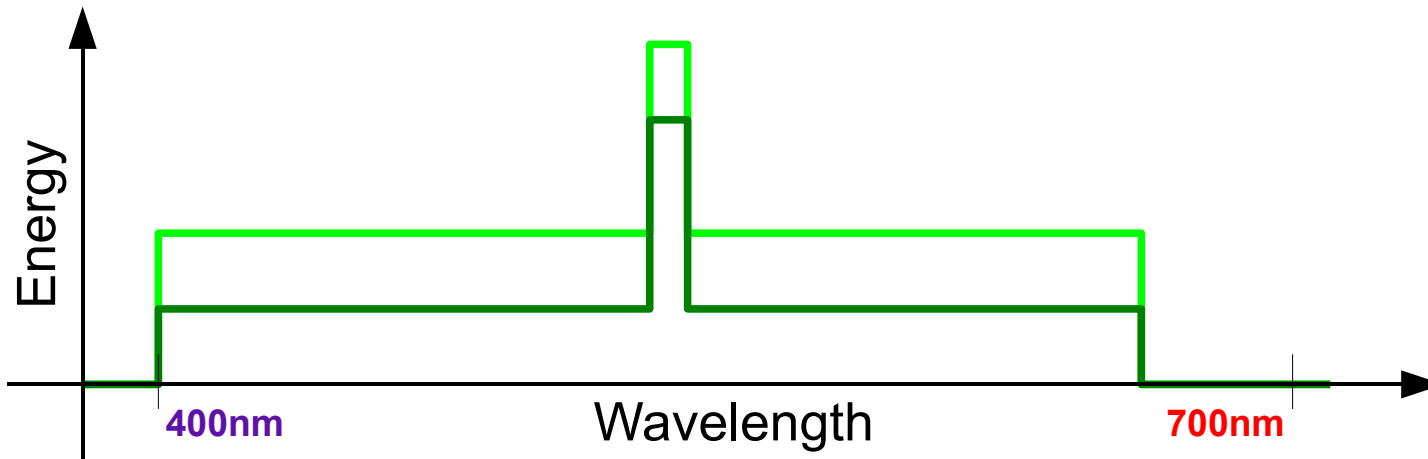


Spectrum



- Hue: Dominant wavelength
- Luminance: Sum of energy, Brightness
- Saturation: Ratio Hue part/Luminance

Spectrum

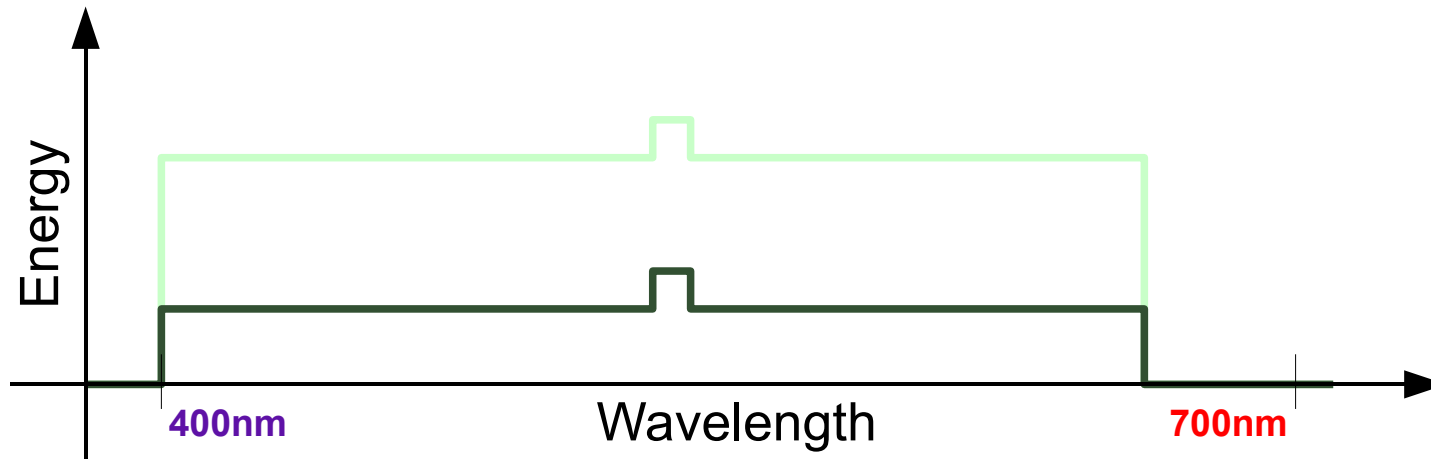


- Hue
- Luminance
- Saturation

High S
Med L

High S
Low L

Spectrum



- Hue
- Luminance
- Saturation

Low S
High L

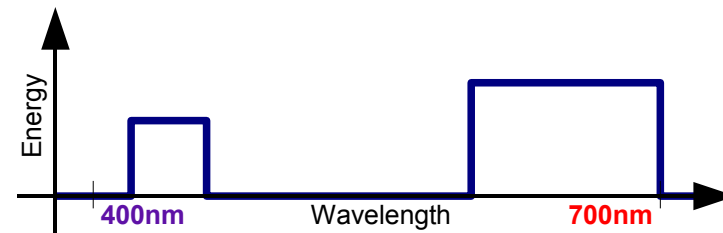
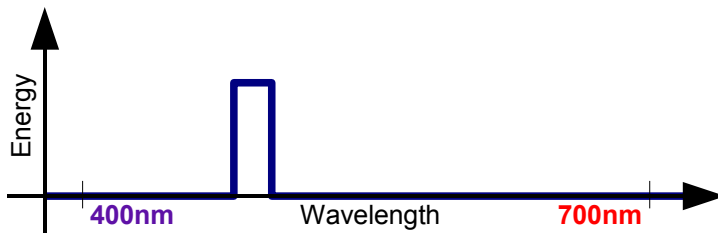
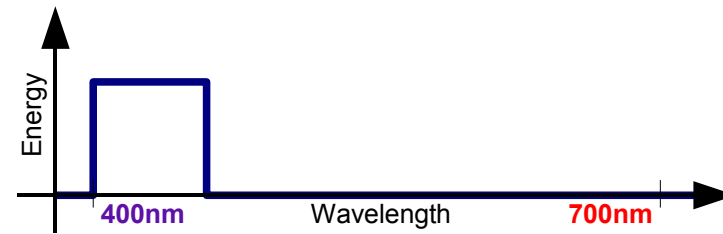
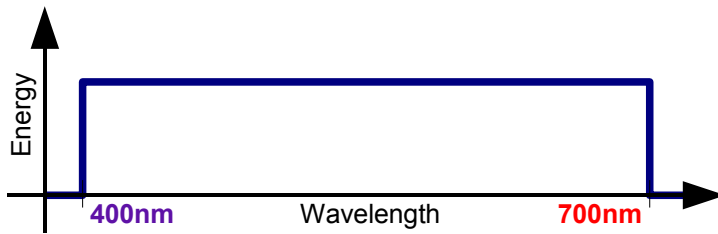
Low S
Low L

Interaction with Materials

- Absorption
 - Transmission
 - Reflection
 - (Combination)
-
- Preservation of Energy

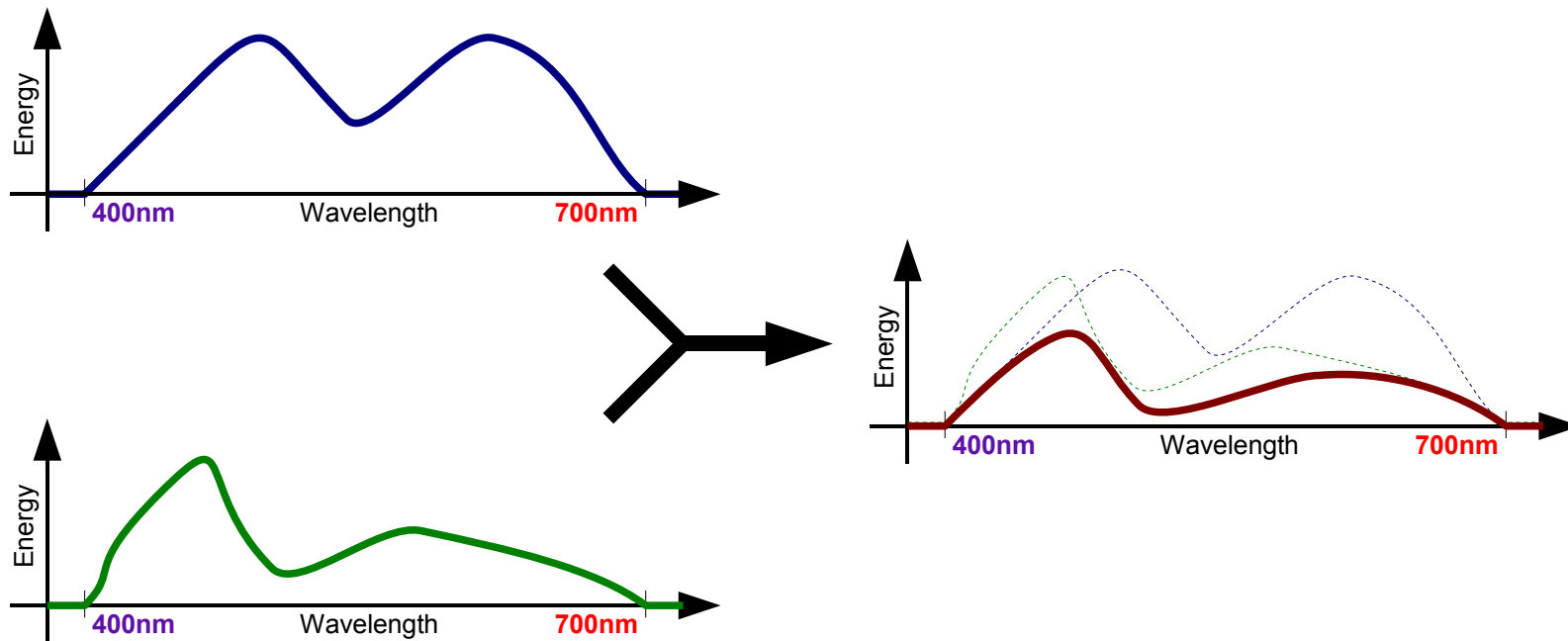
Spectrum

- Spectral Response Function (SRF)



Result

- $SDF \cdot SRF = \text{Result SDF}$



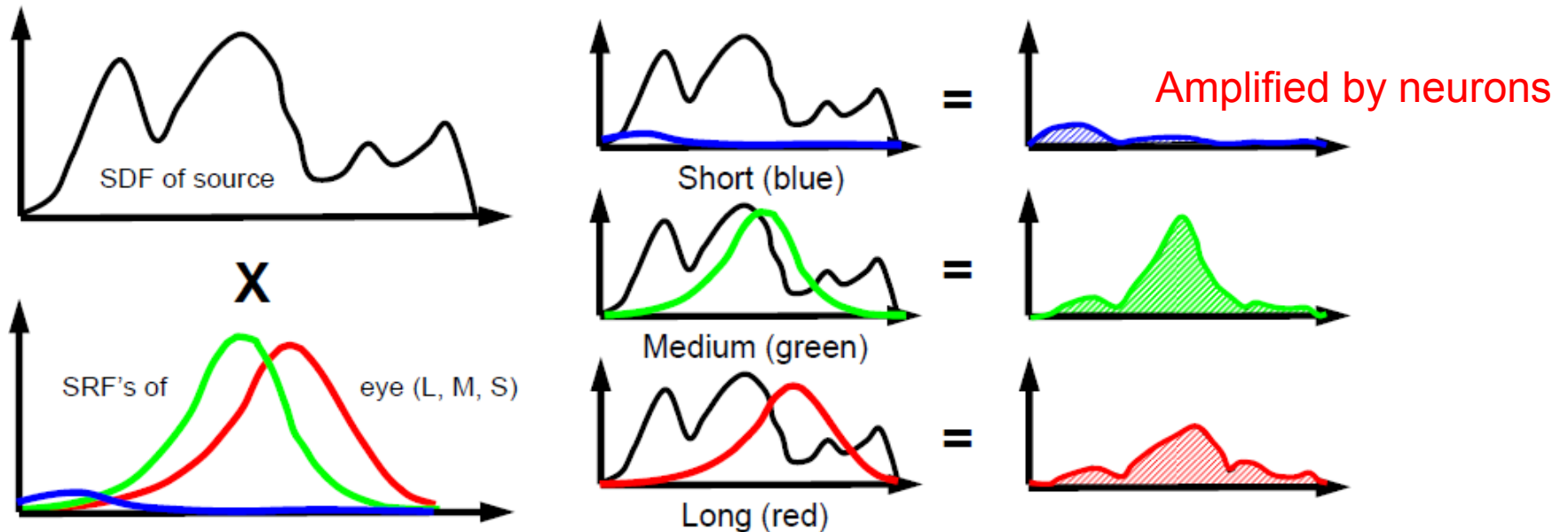
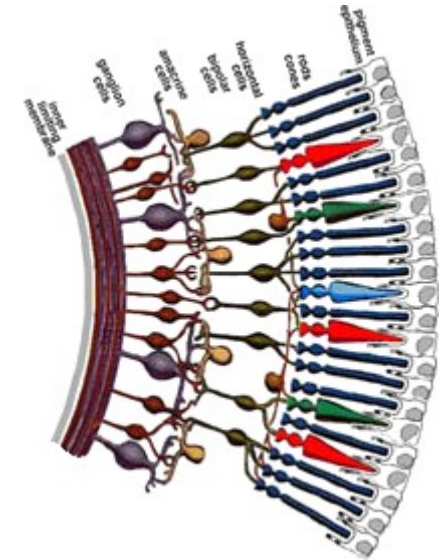
Result

- Light sources defined by their SDF
- Materials defined by their SRF
 - Absorbed Light SRF
 - Surfaces, Eye, CCD chip, ...
 - Reflected Light SRF
 - Mirror, polished surface, ...
 - Transmitted Light SRF
 - Glass, water, ...

Human Eye

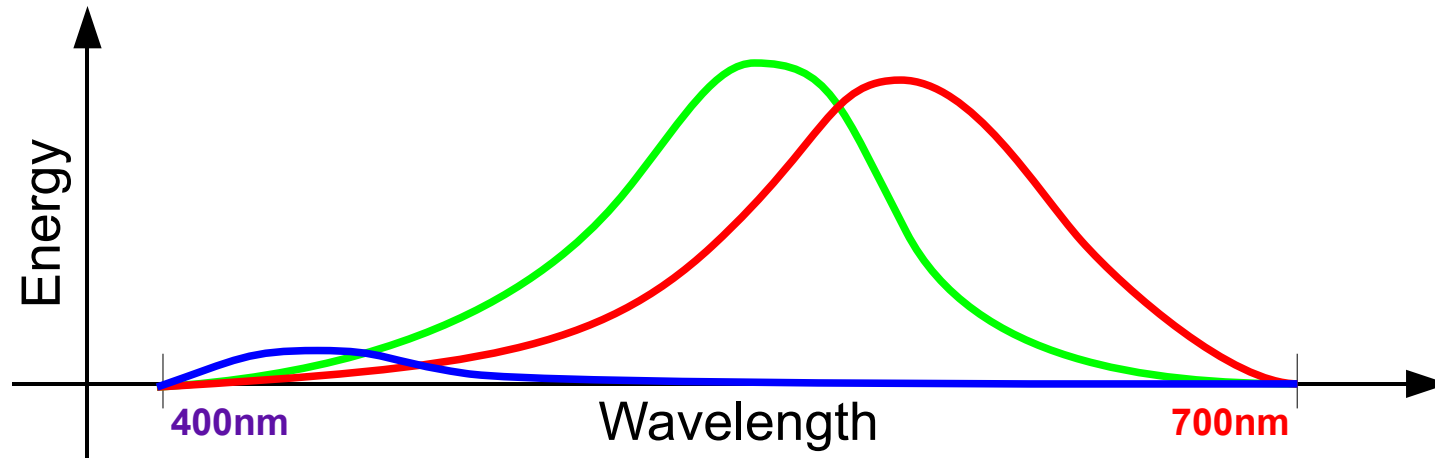
- Receptors for
 - Long/Medium/Short wavelengths (Cone cell, high intensity)
 - Gray value/Intensity (Rod cell, low intensity)

"At night, all cats are gray"



Human Eye

- We can perceive different SDF's as the same colour!



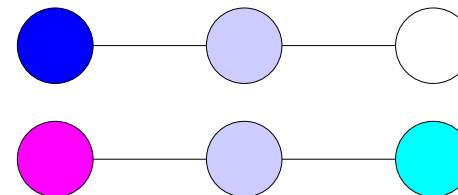
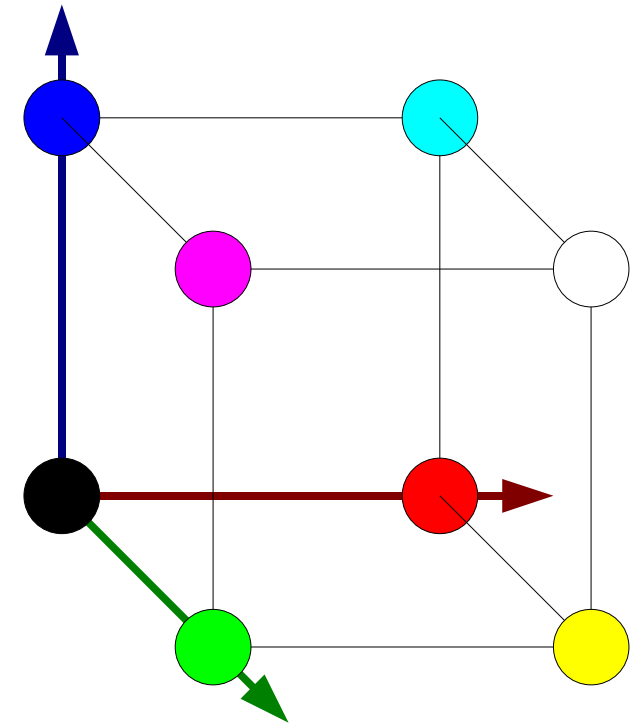
Colour Spaces

- RGB, sRGB, CMYK, YIQ, ypbPr, xvYCC, HSV, HSL
- CIE 1931 XYZ
 - First attempt to produce a colour space based on human perception
- Most common: tristimulus colour space
 - Each dimension a primary colour
 - Values [0...1]

RGB Colour Space

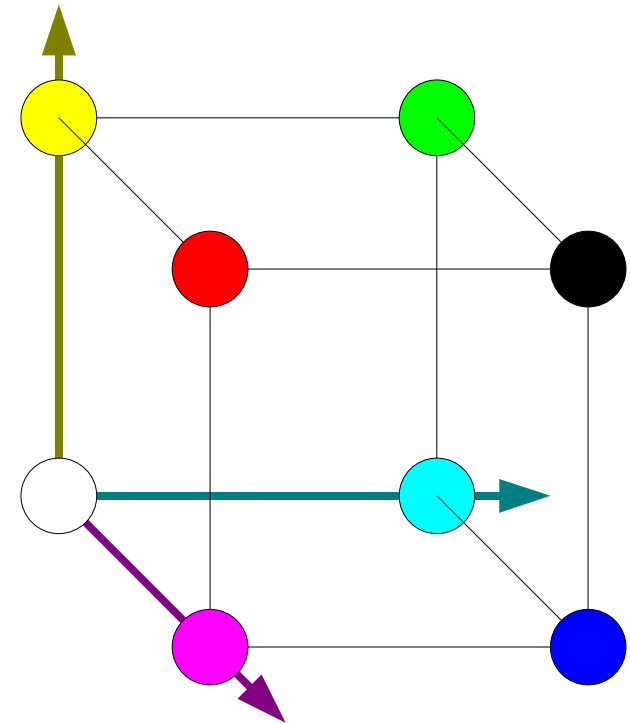
- Components:
 - Red
 - Green
 - Blue
- Easy to understand
- Difficult to handle
 - What is “Brown”?
 - Interpolation problems

Additive



CMYK Colour Space

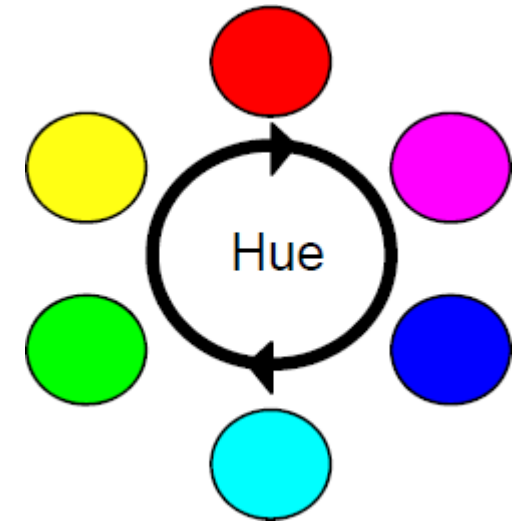
- Components:
 - Cyan
 - Magenta
 - Yellow
 - (Black/Key)
 - Used in Print
 - Also not trivial to handle
- Subtractive**



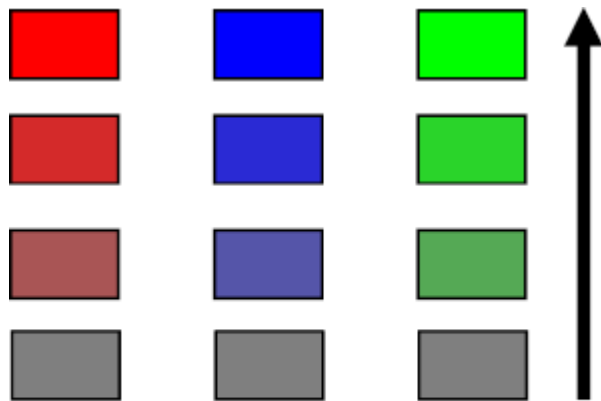
HSL Colour Space

- Components:

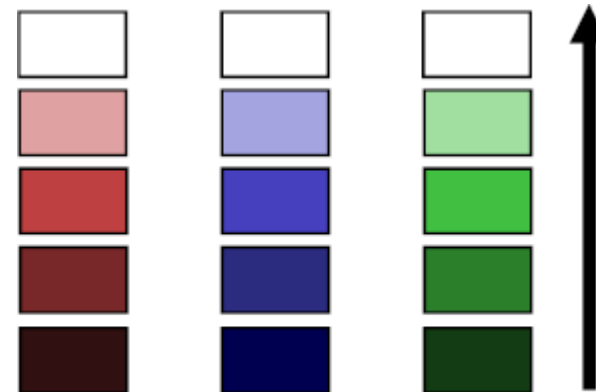
- Hue
- Saturation
- Lightness



- Interpolation is easier and intuitive



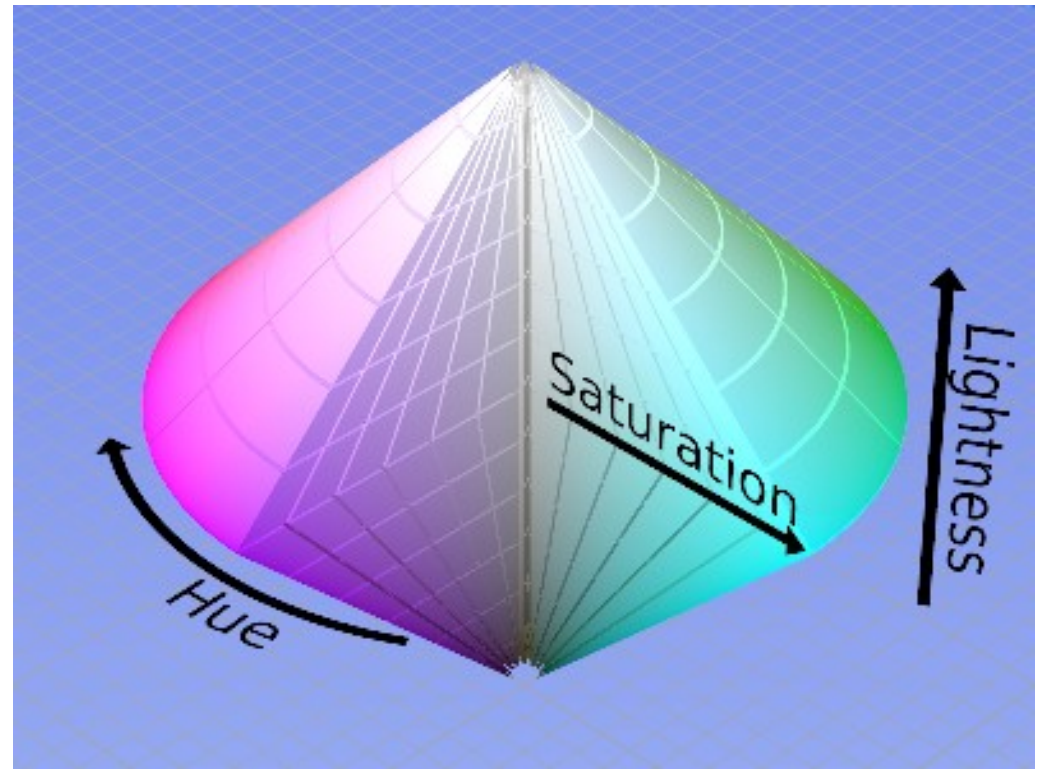
Saturation
(lightness = 50%)



Lightness
(saturation = 50%)

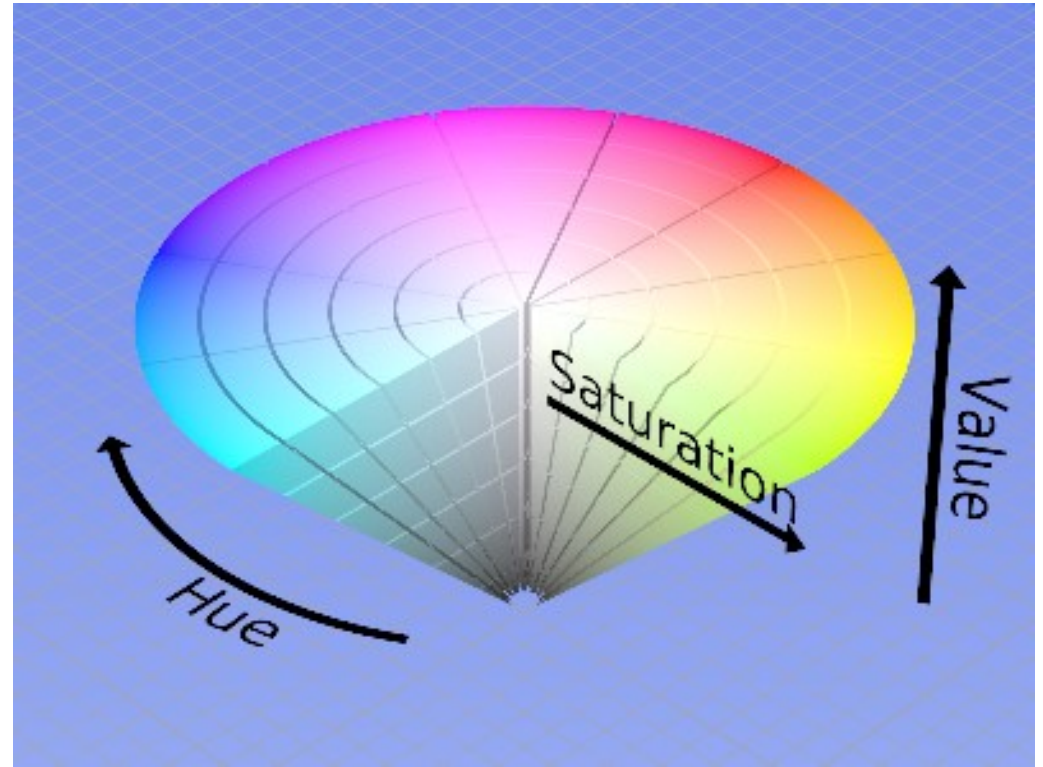
HSL Colour Space

- Components:
 - Hue
 - Saturation
 - Lightness



HSV Colour Space

- Components:
 - Hue
 - Saturation
 - Value

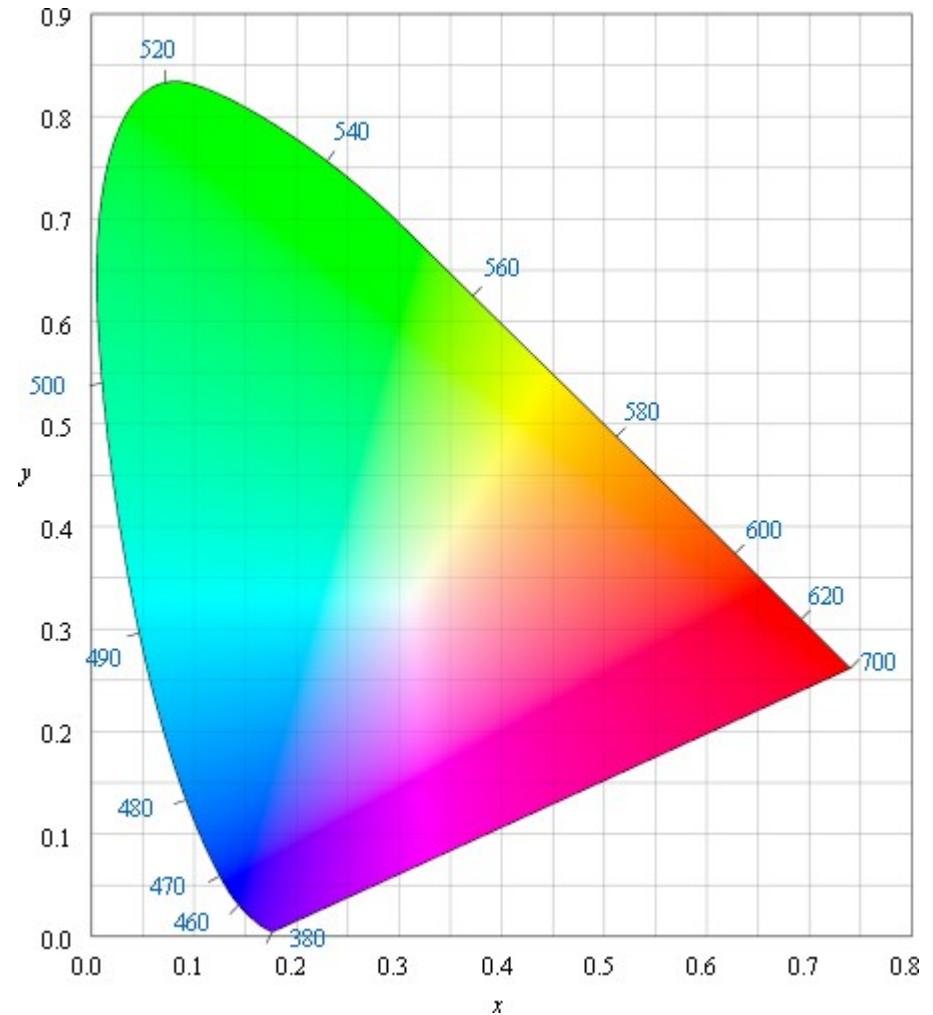


CIE XYZ Colour Space (1931)

- Mother of all colour spaces
- Chromacity Diagram:
 - Normalised coordinates:

$$x = \frac{X}{X + Y + Z}$$

$$y = \frac{Y}{X + Y + Z}$$



CIE XYZ Colour Space (1931)

- Easy to interpolate
- Gamut of human perception (average person)
- Gamuts of devices are subsets

