

Computer Graphics

Tutorial for Exercise Sheet 01

Exercise 1: Output Devices

a) Frequency 60 Hz

- Picture generated in $1/60$ s

$$\frac{\frac{1}{60} \left[\frac{s}{frame} \right]}{3840 \times 2160 \left[\frac{pixel}{frame} \right]} = 0.000000002 [s/pixel] = 2 [ns/pixel]$$

b) 24 Bit means 2^{24} colors can be displayed

- Called “True Color”, 8 Bit for every color channel (RGB)

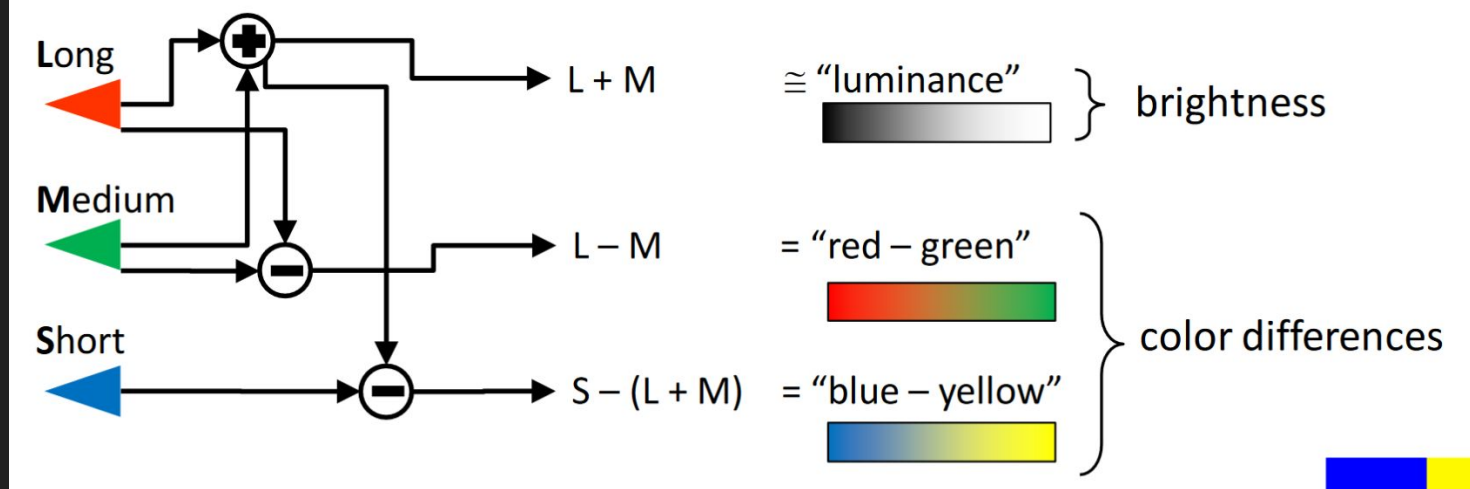
$$(3840 \times 2160) \left[\frac{pixel}{frame} \right] 60 \left[\frac{frame}{s} \right] 24 \left[\frac{Bit}{pixel} \right] \approx 11.94 \left[\frac{GBit}{s} \right] = 1.49 \left[\frac{GB}{s} \right] = 1.39 \left[\frac{GiB}{s} \right]$$

Exercise 1: Output devices

	HDMI version				
	1.0–1.2a	1.3–1.3a	1.4–1.4b	2.0–2.0b	2.1
Release date	Dec 2002 (1.0) ^[129] May 2004 (1.1) Aug 2005 (1.2) ^[130] Dec 2005 (1.2a) ^[131]	Jun 2006 (1.3) ^[132] Nov 2006 (1.3a) ^[5]	Jun 2009 (1.4) ^[133] Mar 2010 (1.4a) ^[109] Oct 2011 (1.4b)	Sep 2013 (2.0) ^[113] Apr 2015 (2.0a) ^[134] Mar 2016 (2.0b)	Nov 2017 ^[135]
Signal specifications					
Max. transmission bit rate (Gbit/s) ^[a]	4.95	10.2	10.2	18.0	48.0
Max. data rate (Gbit/s) ^[b]	3.96	8.16	8.16	14.4	42.0

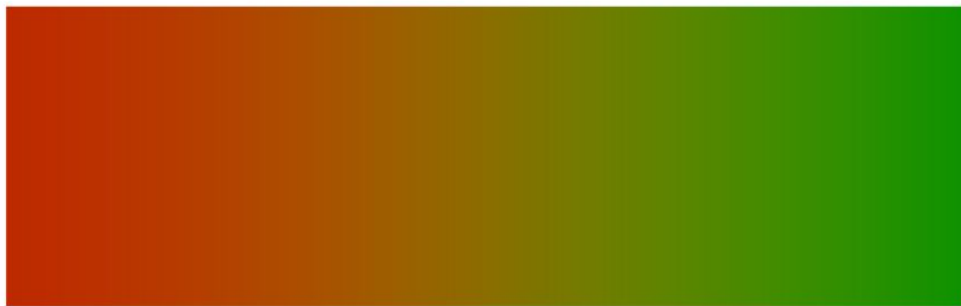
Exercise 2: Perception

- a) Human brain perceives color by combining two spectra red-green and blue-yellow.
- i) Mixing red and green leads to cancellation of the colors.
 - ii) Mixing red and yellow leads to a combined color



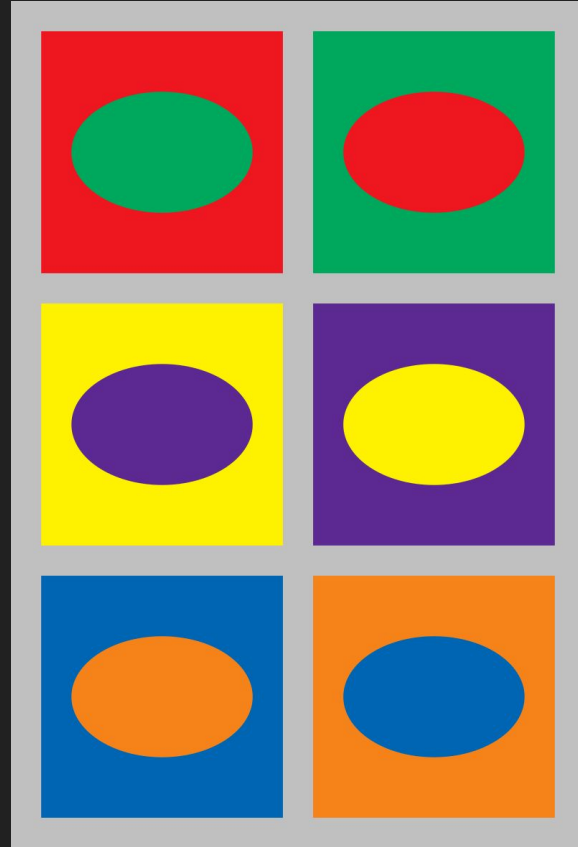
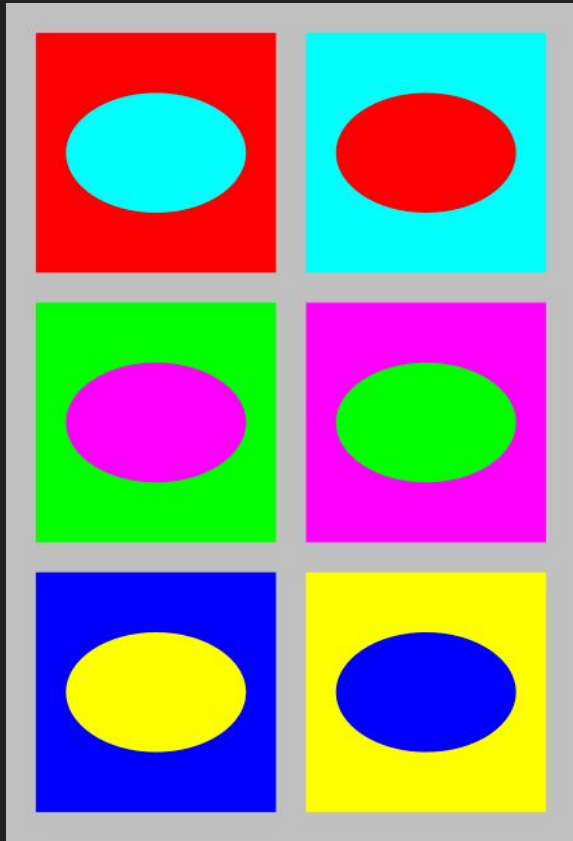
Exercise 2: Perception

a)

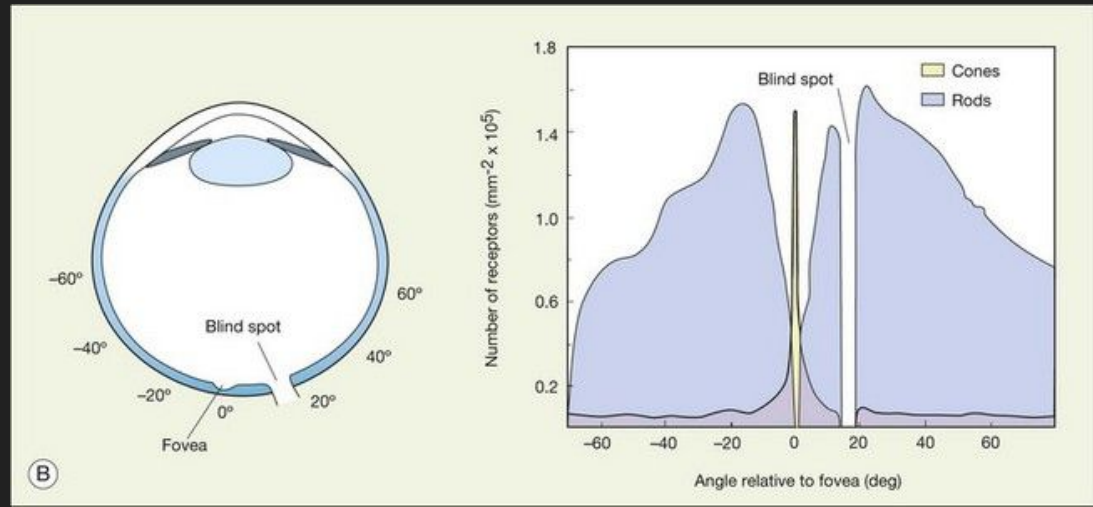


Exercise 2: Perception

a)



Exercise 2: Perception



b) Focusing point of human eye is called **Fovea**

Most cones (color perceiving cells) are found there

-> Very dim stars can not be seen in focus

-> Look slightly beneath the star to see (most rods there)

Exercise 2: Perception

c) Metamerism: Matching perception of vision although different power spectra

Colors that match this way are called **metamers**.

Combination of surface and light properties



Exercise 3: Radiometry

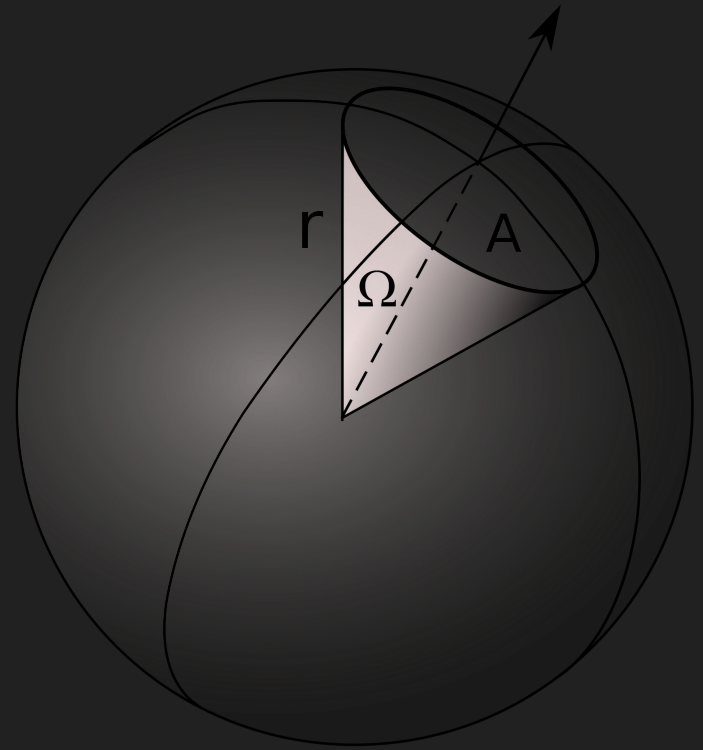
$$a = \sqrt{d_{Se}^2 + r_E^2}$$

$$A_E = 2\pi a \left(a - \sqrt{a^2 - r_E^2} \right) \approx \pi r_E^2$$

$$\Omega = \frac{A_E}{d_{SE}^2} \approx 5.71 \cdot 10^{-9} \text{ sr}$$

$$\frac{\Phi_E}{\Phi_S} = \frac{\Omega}{4\pi} \approx 4.54 \cdot 10^{-10}$$

$$\Phi_E = \Phi_S \cdot \frac{\Omega}{4\pi} \approx 1.75 \cdot 10^{17} \text{ Watts}$$



Exercise 4: 3D Visual Perception

- Stereoscopy: Representation of images with perception of depth
 - 3D vision is product of brain, combines two 2D images from each eye
- Each eye sees slightly different angle of same scene
- Information gets processed in the brain to sense and approximate distance to objects
- Anaglyph 3D
- Polarized Light

