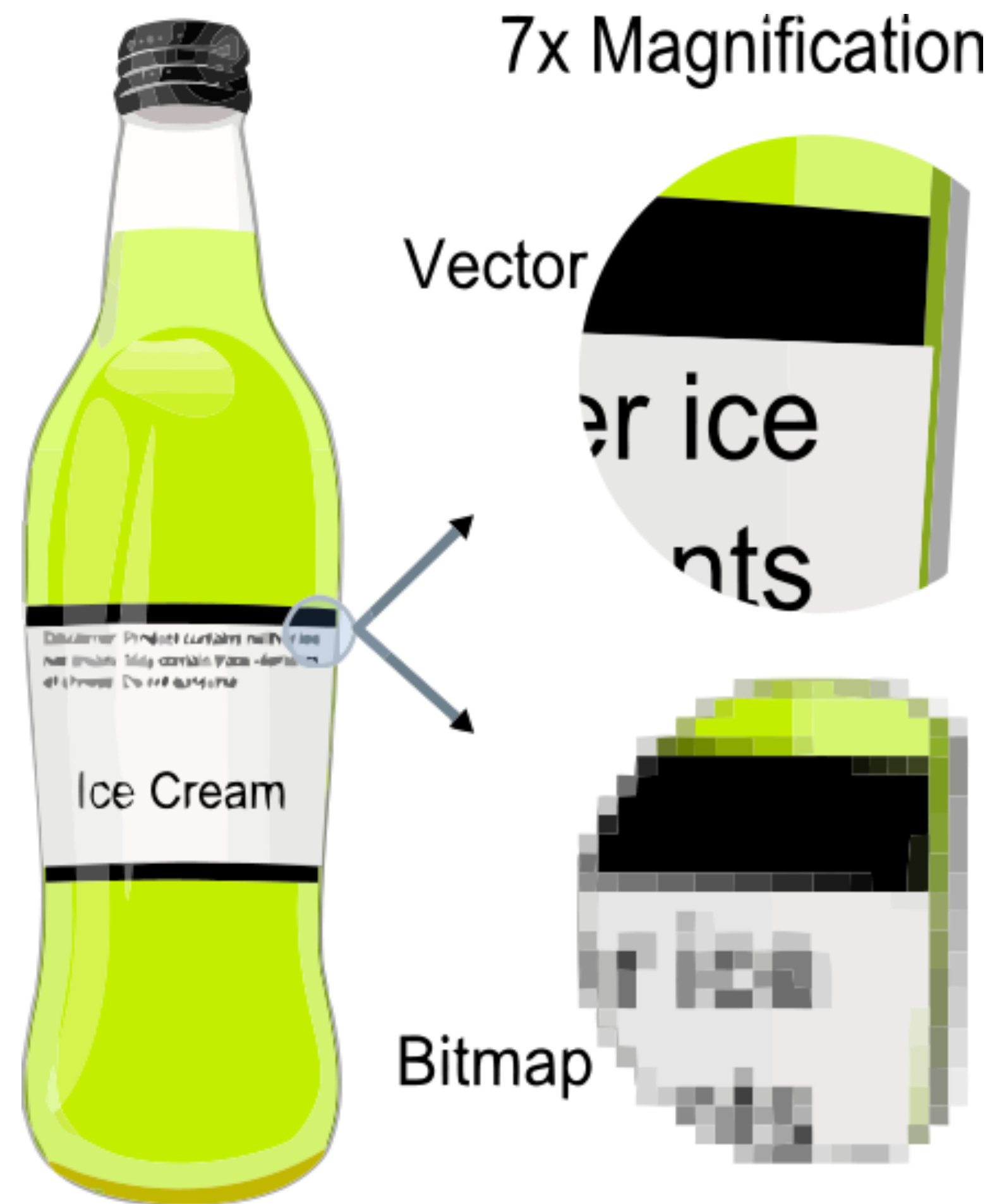


# Images

# Images

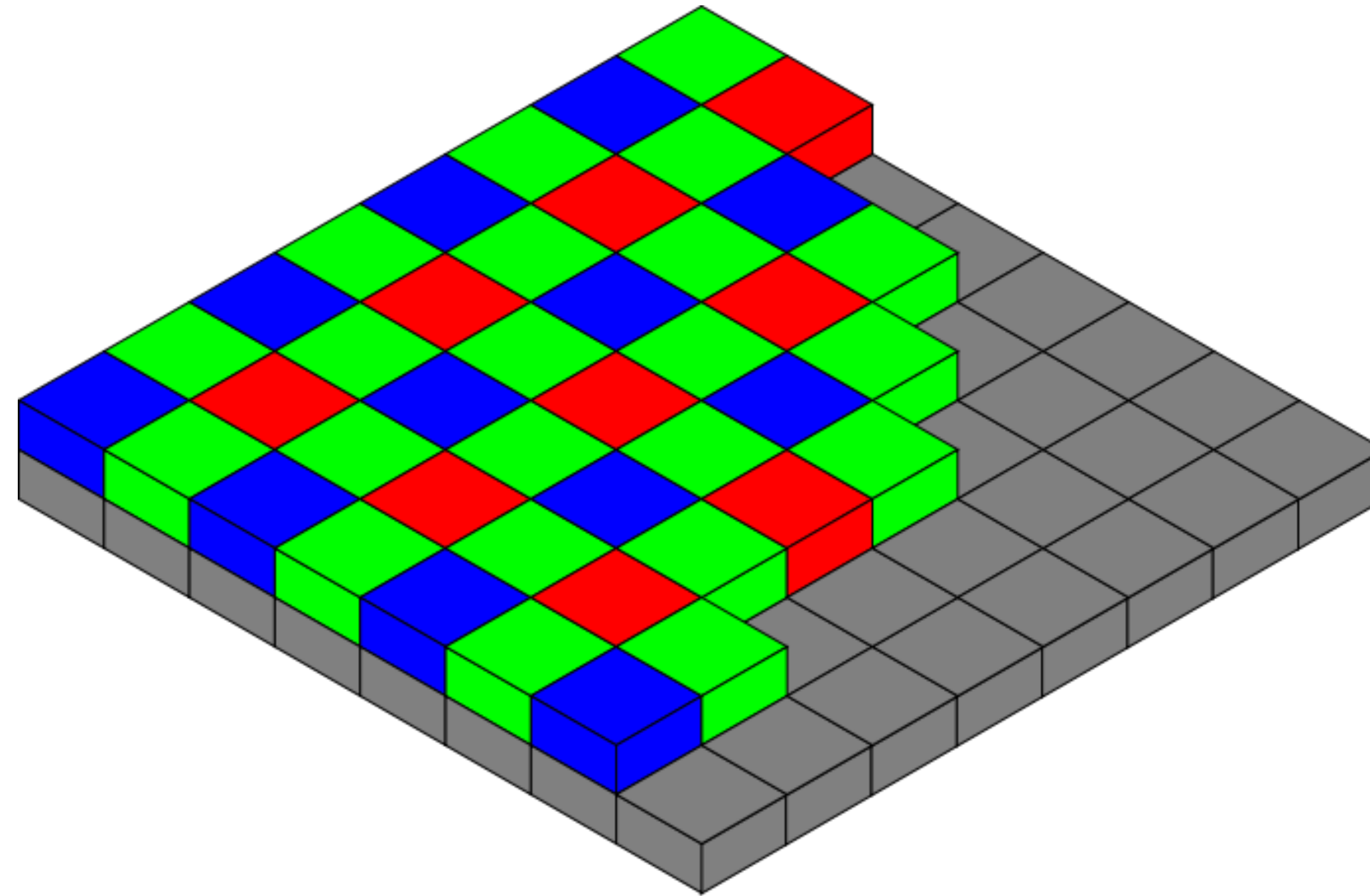


By The original uploader was DARTH Stabro at English Wikipedia - Transferred from en.wikipedia to Commons by Pbroks13 using CommonsHelper., CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=15789788>

# Raster Devices

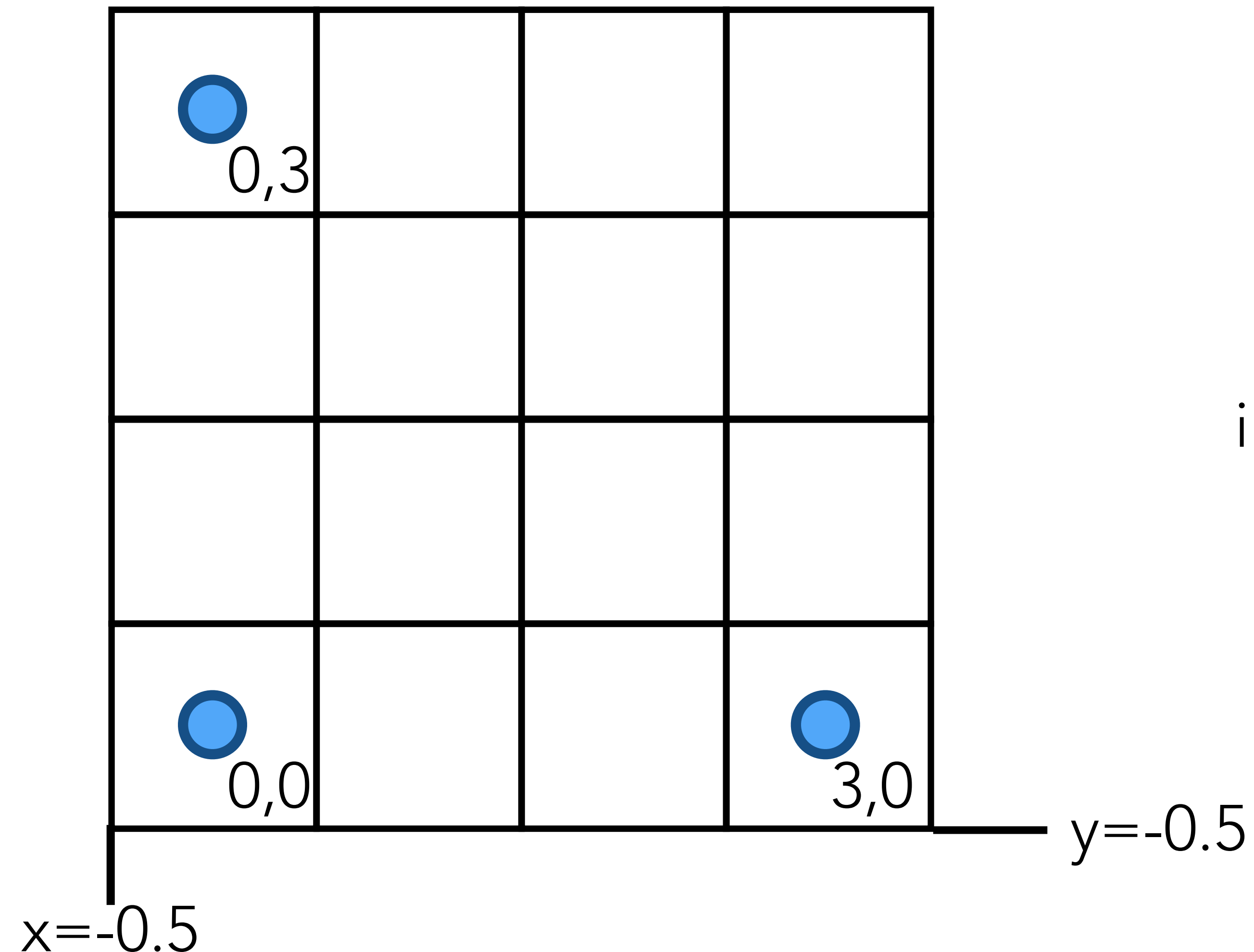
- Output
  - 2D: Display (LCD,LED)
  - 1D: Hardcopy (ink-jet, dye sublimation)
- Input
  - 2D Array: digital camera
  - 1D Array: scanner

# Bayesian Color-Filter



By en:User:Cburnett - Own workThis vector image was created with Inkscape., CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=1496858>

# Pixel Coordinates - Raster Image



Be Careful:  
Y is flipped  
in some APIs

# Pixel Values (Framebuffer format)

- 1-bit greyscale - text
- 8-bit RGB (24 bits) - web and email
- 8-bit RGBA (32 bits) - alpha channel, see next slide
- 16/24/32bits - high accuracy for photography and HDR



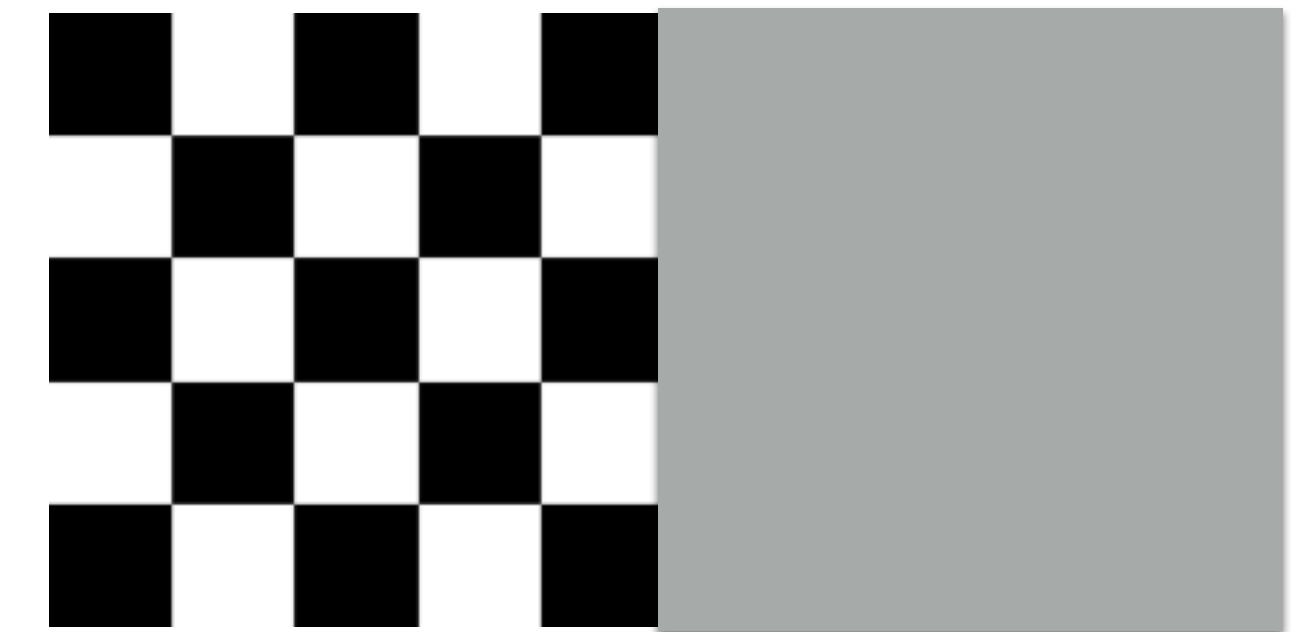
# Monitors Intensity, Gamma Correction

- What is the minimal and maximal light intensity?
- The intermediate intensities are different for each person, and it is non-linear
- Monitors needs to be calibrated for a certain viewer, using a procedure called "Gamma Correction"
- The rule is simple:  $\text{displayed intensity} = (\text{max intensity}) * a^\gamma$   
Pixel Value

# Gamma Correction



- Find the neutral gray:  $0.5 = a^\gamma$
- Compute 
$$\gamma = \frac{\ln 0.5}{\ln a}$$



- The colors will not be uniform on normal screens, one of the major factor affecting the cost of screens is their ability to be consistent on all pixels!

By X-romix 10:00, 7 June 2008 (UTC), Updated by --Rubybrian (talk) 14:25, 14 September 2010 (UTC); Photographer: Toni Frissell - This file was derived from: Weeki Wachee spring 10079u.jpg, GFDL, <https://commons.wikimedia.org/w/index.php?curid=4176109>

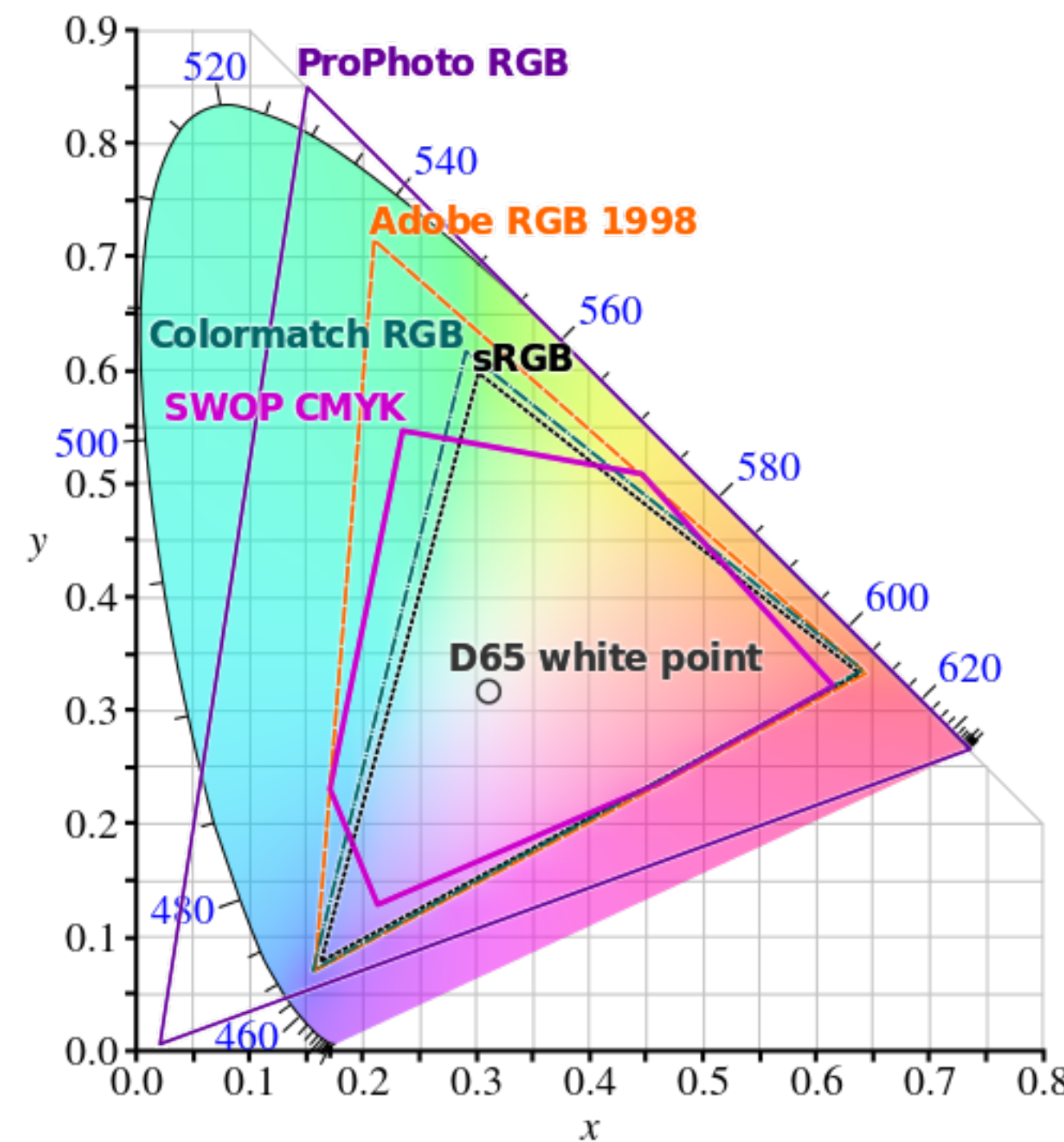


# RGB vs CMYK colors

- RGB is additive



- CMYK is subtractive

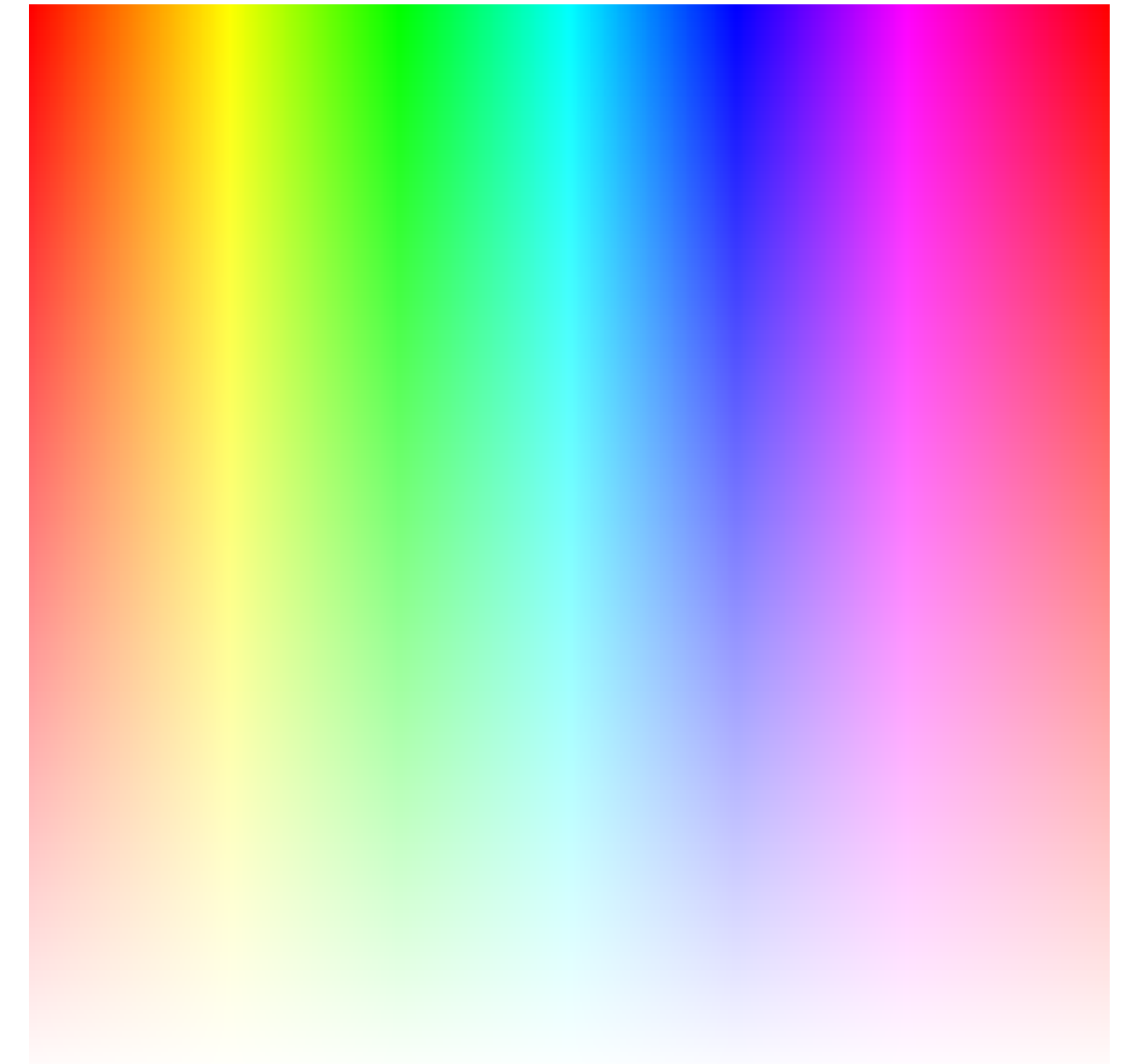


By BenRG and cmglee - [http://commons.wikimedia.org/wiki/File:CIE1931xy\\_blank.svg](http://commons.wikimedia.org/wiki/File:CIE1931xy_blank.svg), CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=32158329>

Calibration is very important!

# Alpha Compositing

$\alpha = 1$



$\alpha = 0$

- A way to represent transparency
- The pixels of an image are blended linearly with the image below
- $\mathbf{c} = \alpha \mathbf{c}_{\text{new}} + (1 - \alpha) \mathbf{c}_{\text{old}}$

RGBA is very common, and you will use it often!

# Image Formats

- Lossy:
  - **jpeg** - compact, introduces artifacts
- Lossless:
  - **png** - common for web applications
  - **ppm** - very simple, not compressed
  - **tiff** - mostly scientific use

# References

**Fundamentals of Computer Graphics, Fourth Edition**  
4th Edition **by Steve Marschner, Peter Shirley**

Chapters 1,2,3