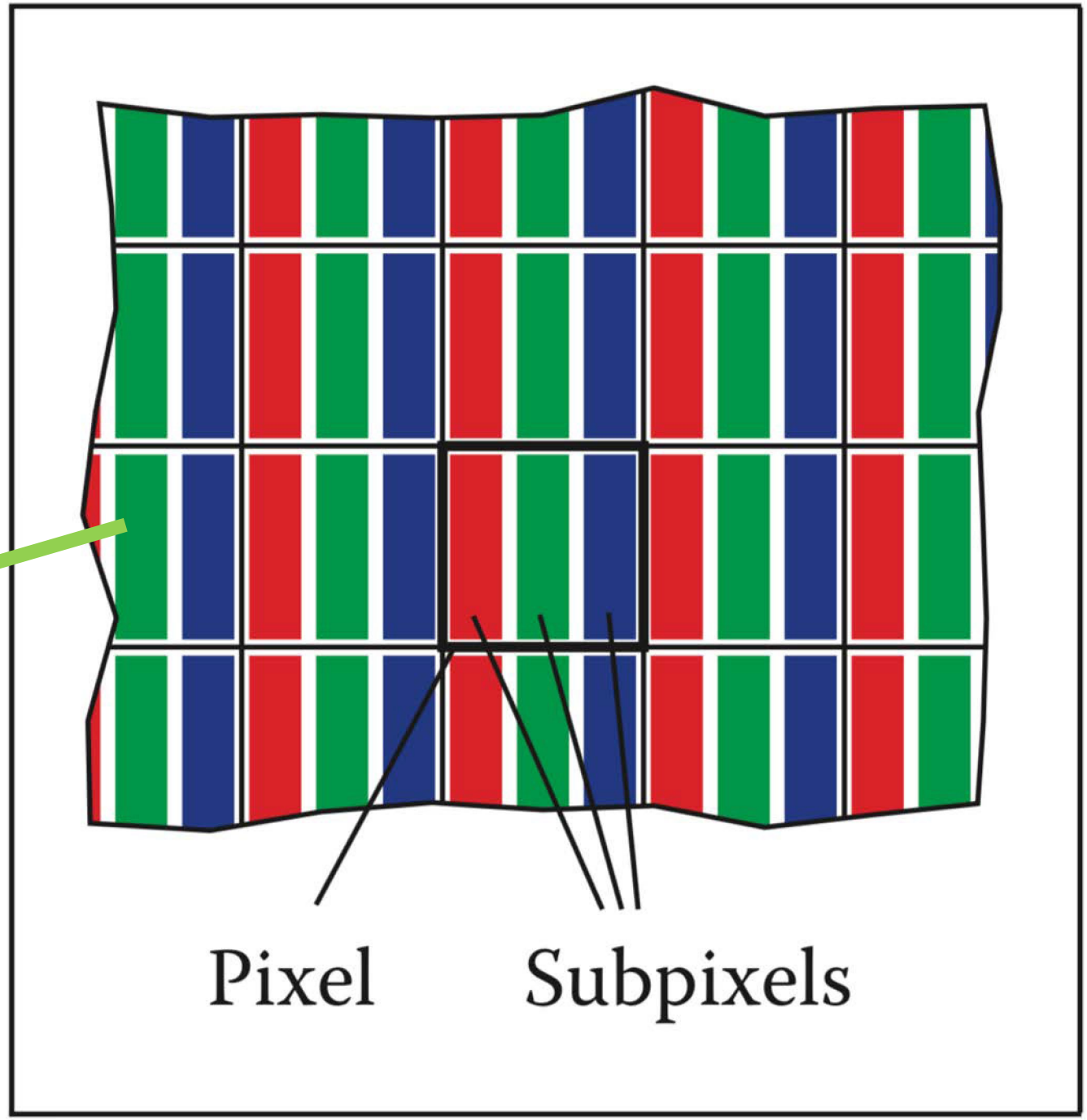
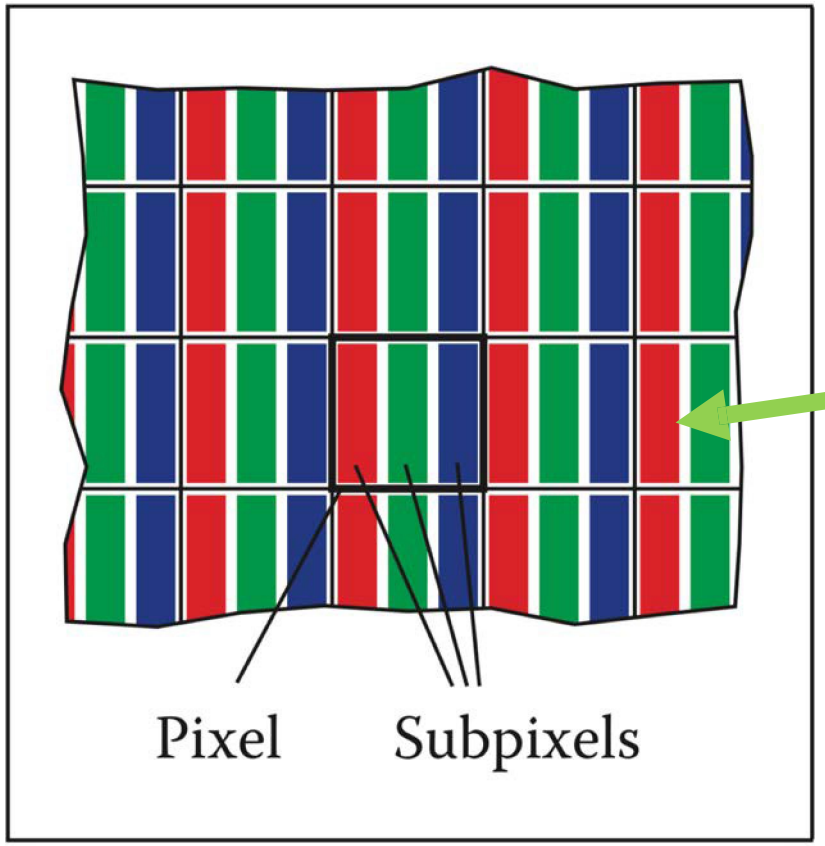
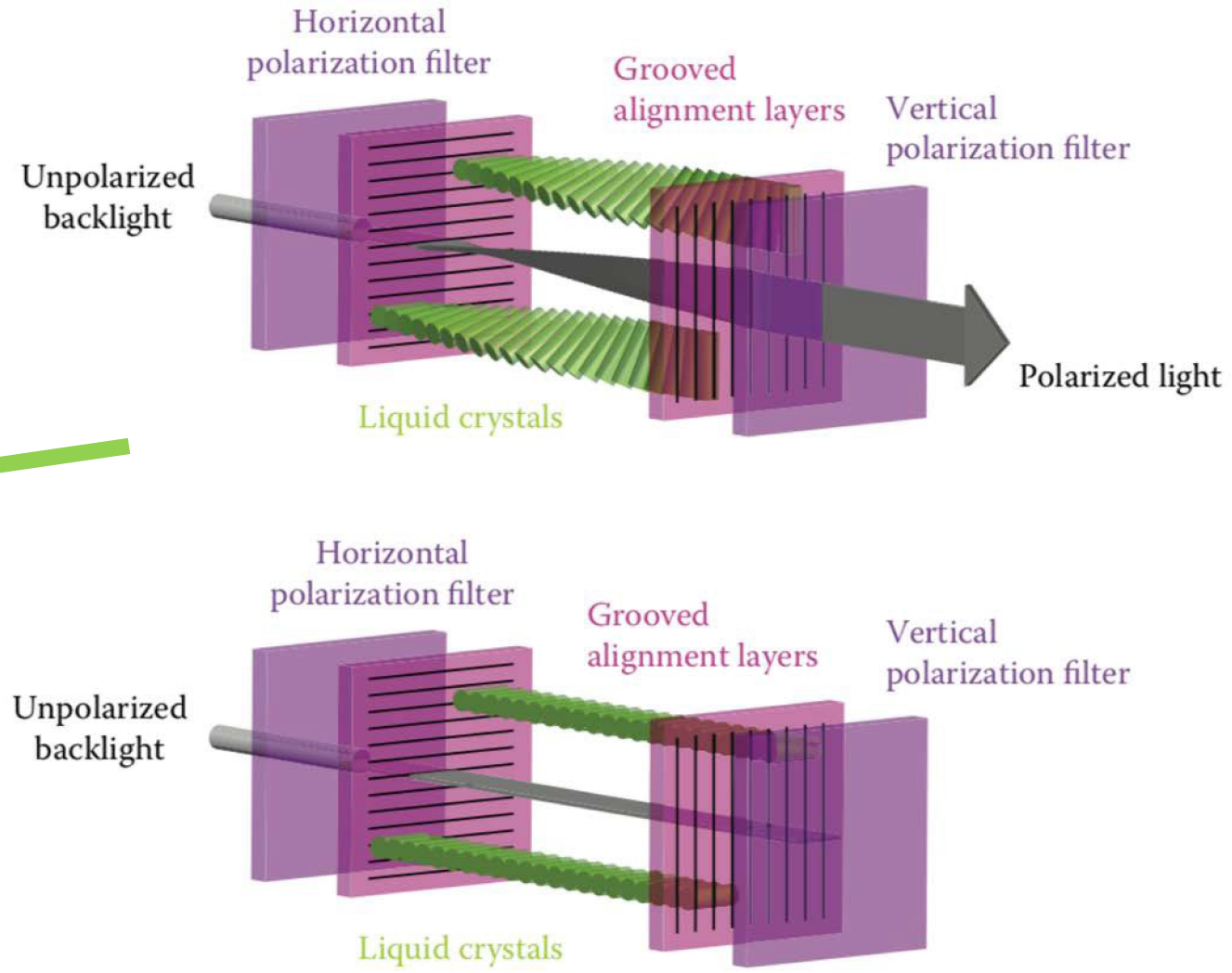
Raster Images

Raster Displays

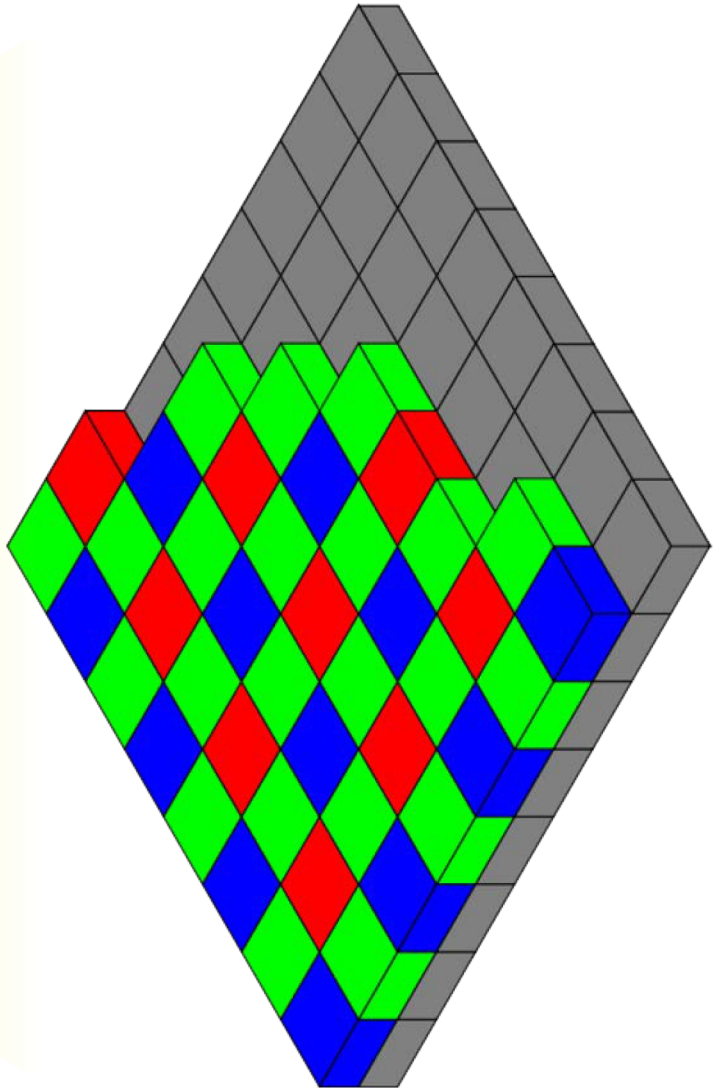


Raster Displays



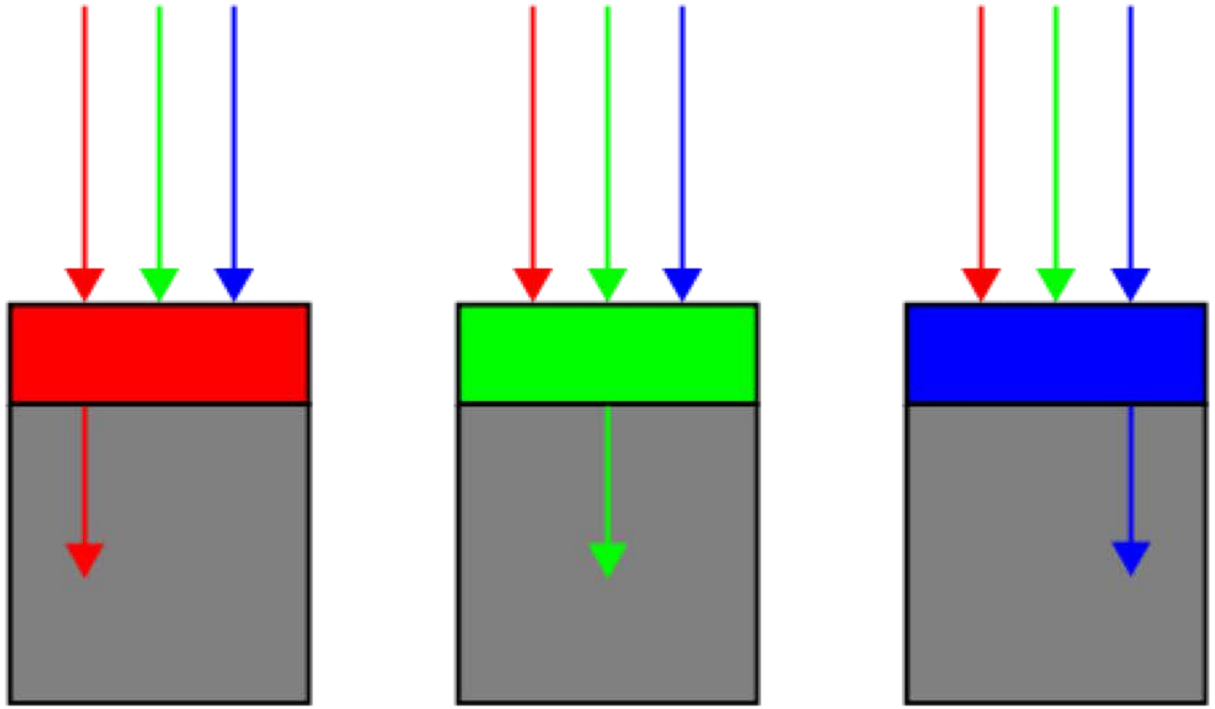


Raster Input Devices



Bayer Filter

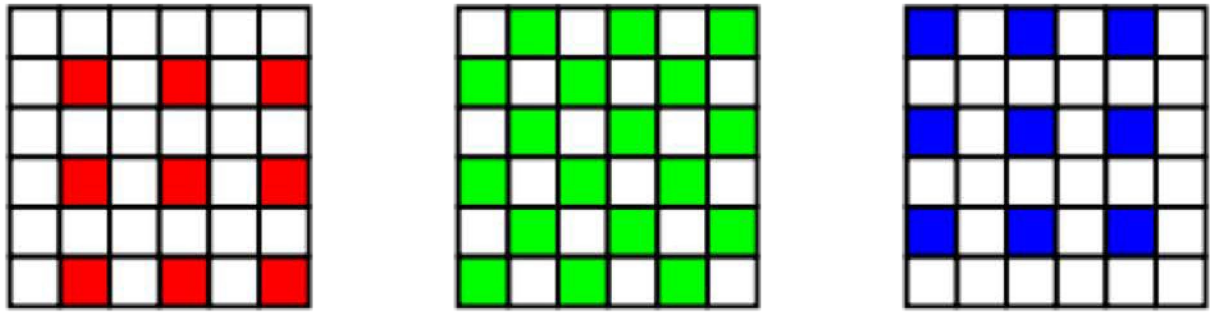
Raster Input Devices



Incoming light

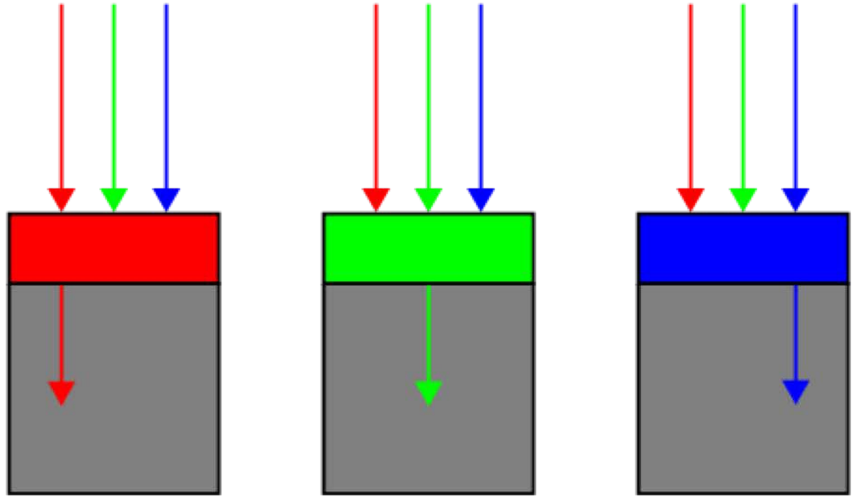
Filter layer

Sensor array



Resulting pattern

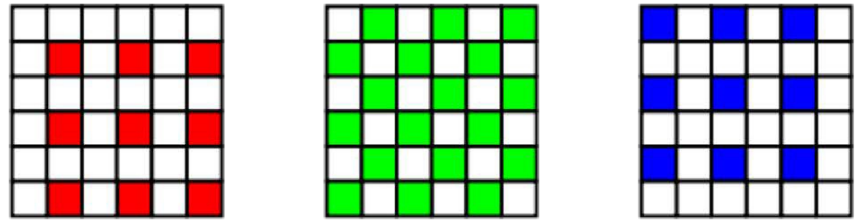
Raster Input Devices



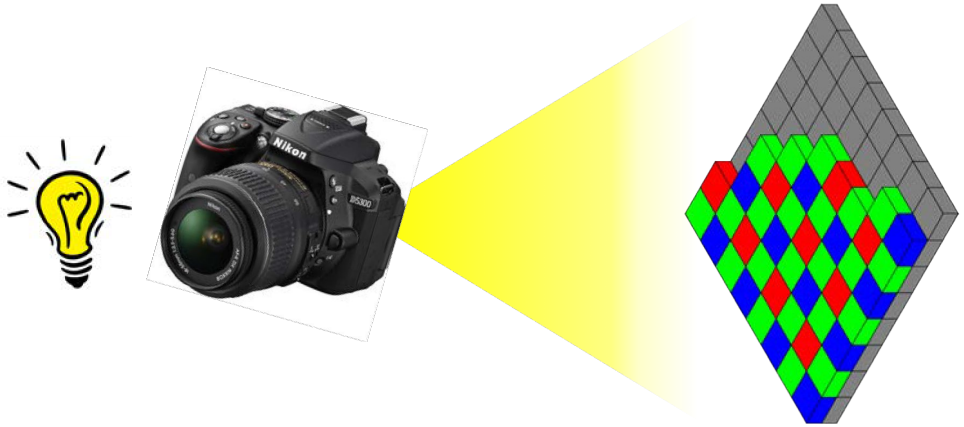
Incoming light

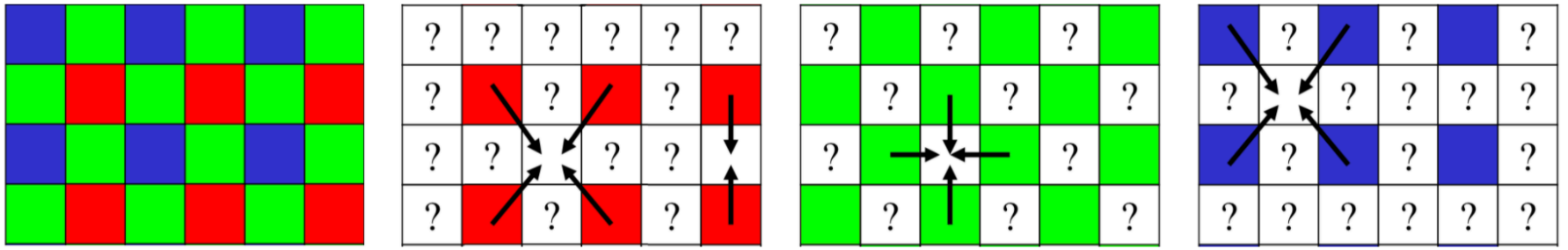
Filter layer

Sensor array

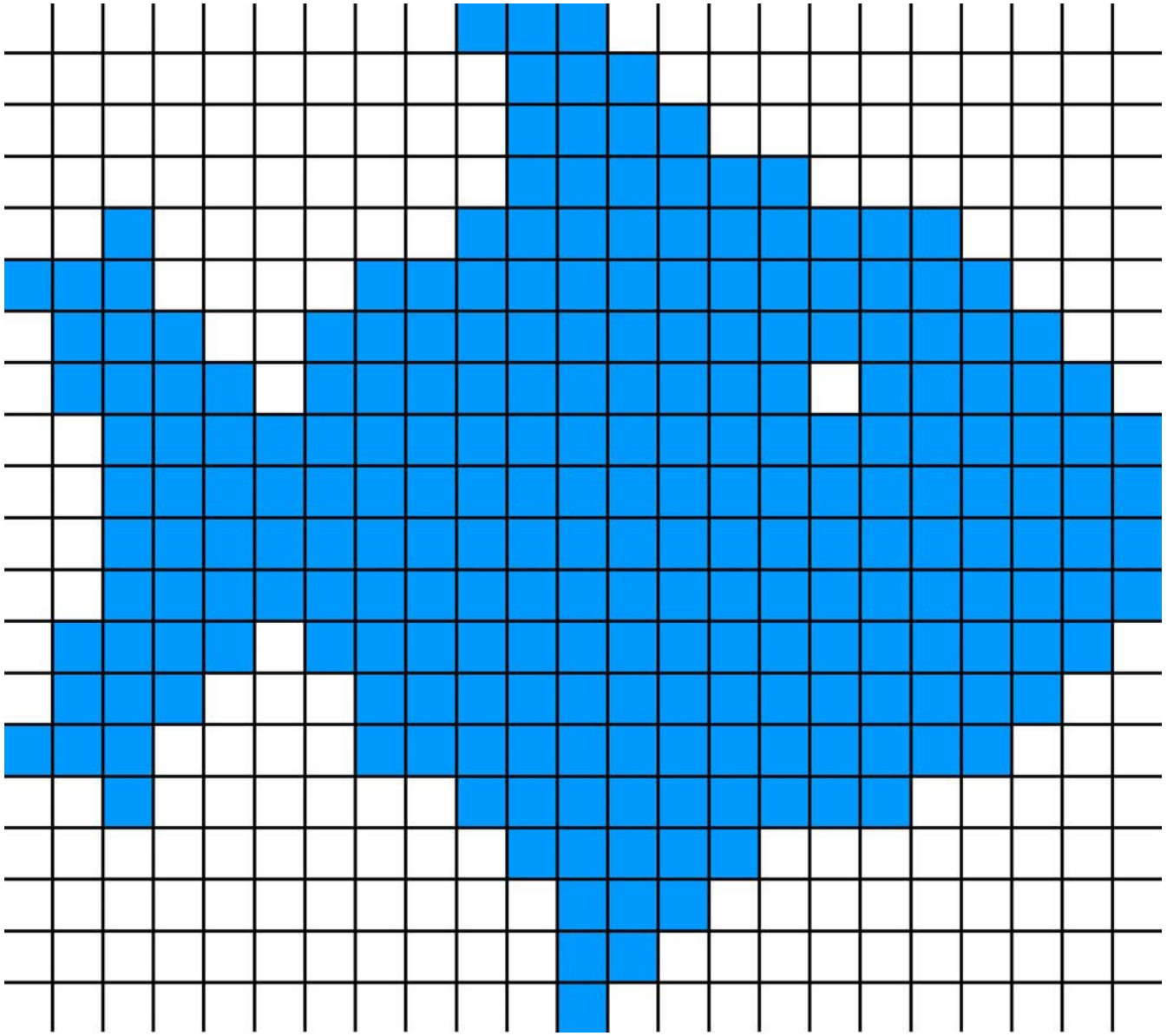


Resulting pattern

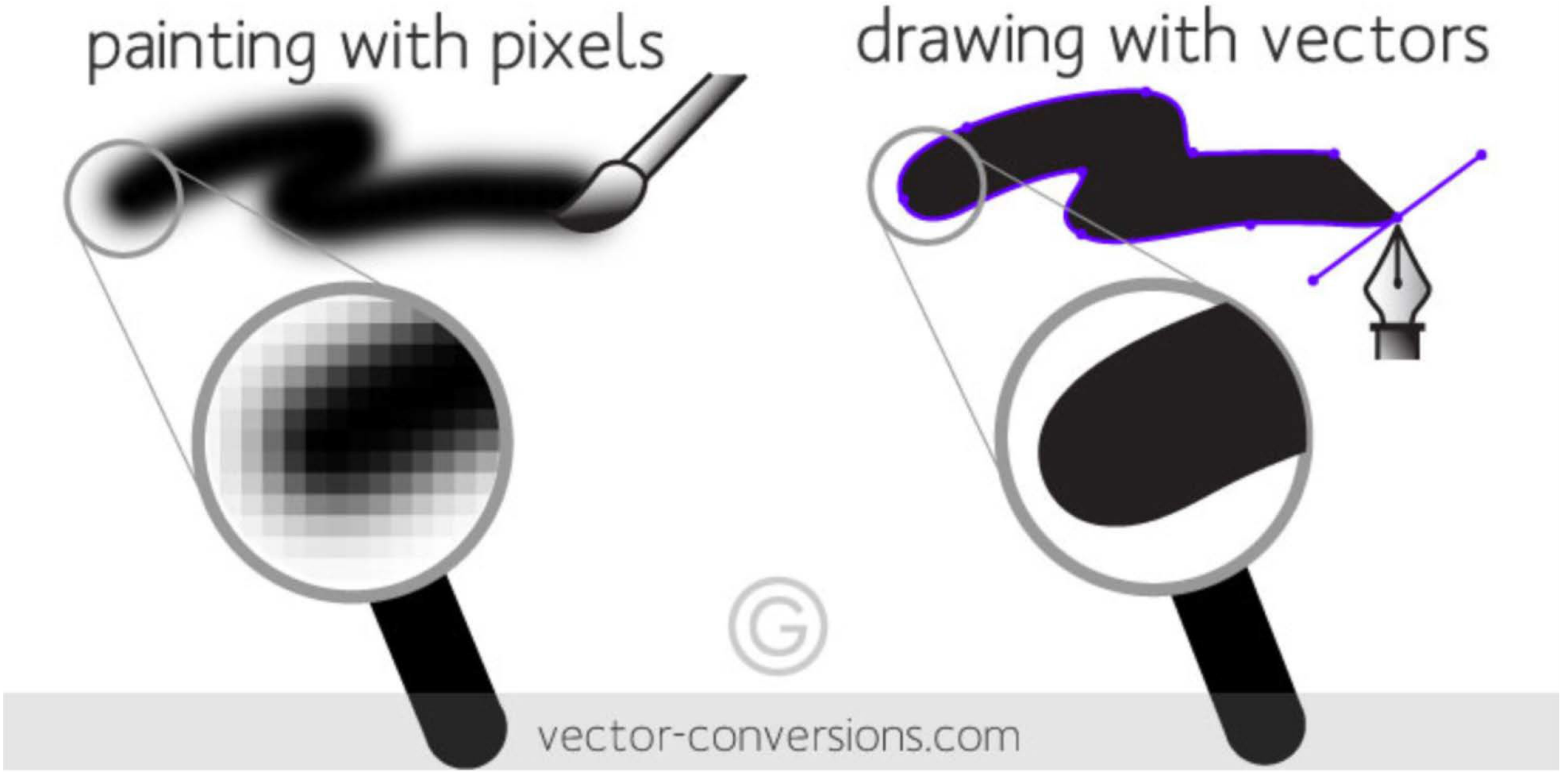




Raster Image



Aside: More Than Just Raster Images

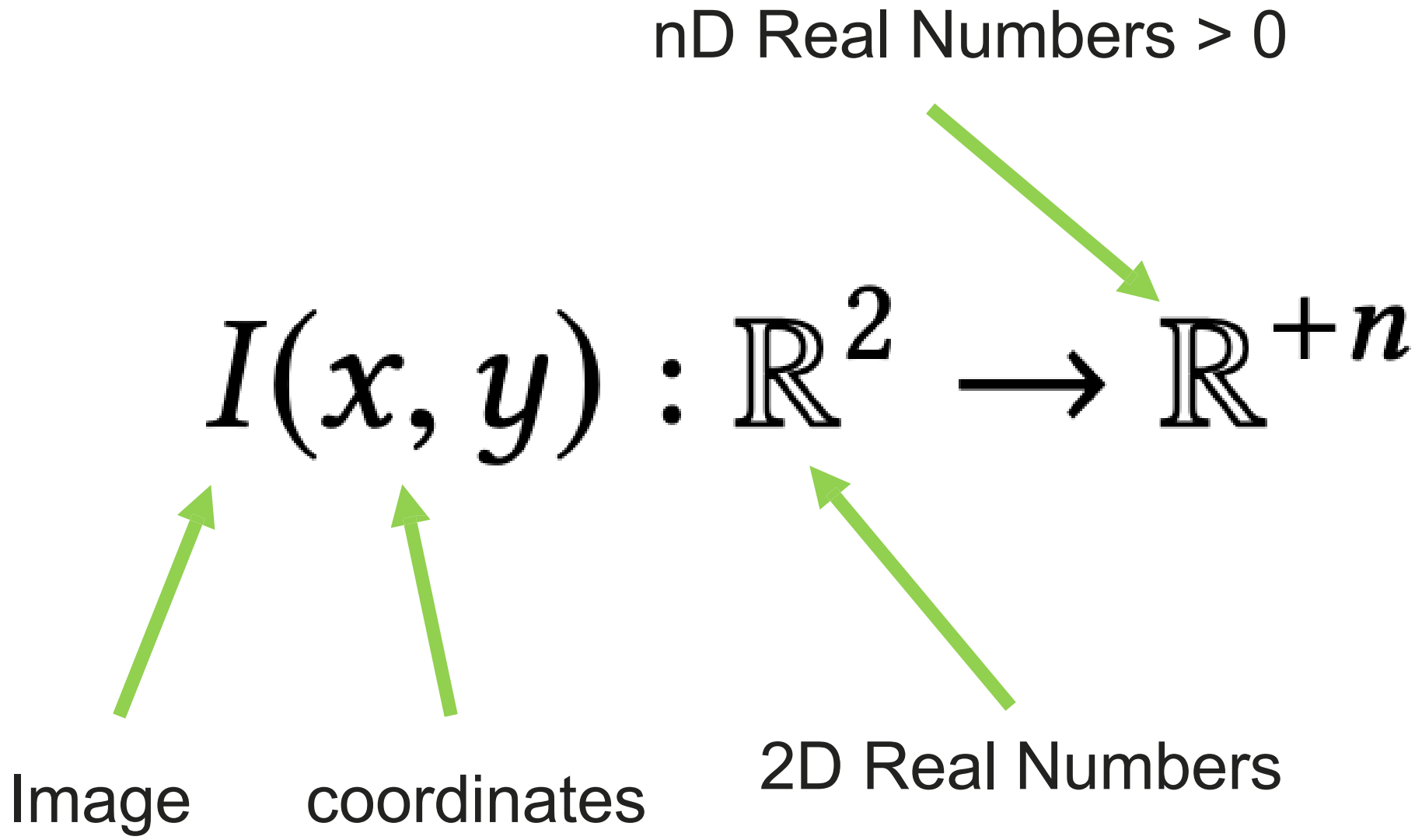


Images as a Function

$$I(x, y) : \mathbb{R}^2 \rightarrow \mathbb{R}^{+n}$$

Image coordinates ????

Images as a Function



Images as a Function

3D Real Numbers > 0

R,G,B values

$$I(x, y) : \mathbb{R}^2 \longrightarrow \mathbb{R}^{+3}$$

Images as a Function

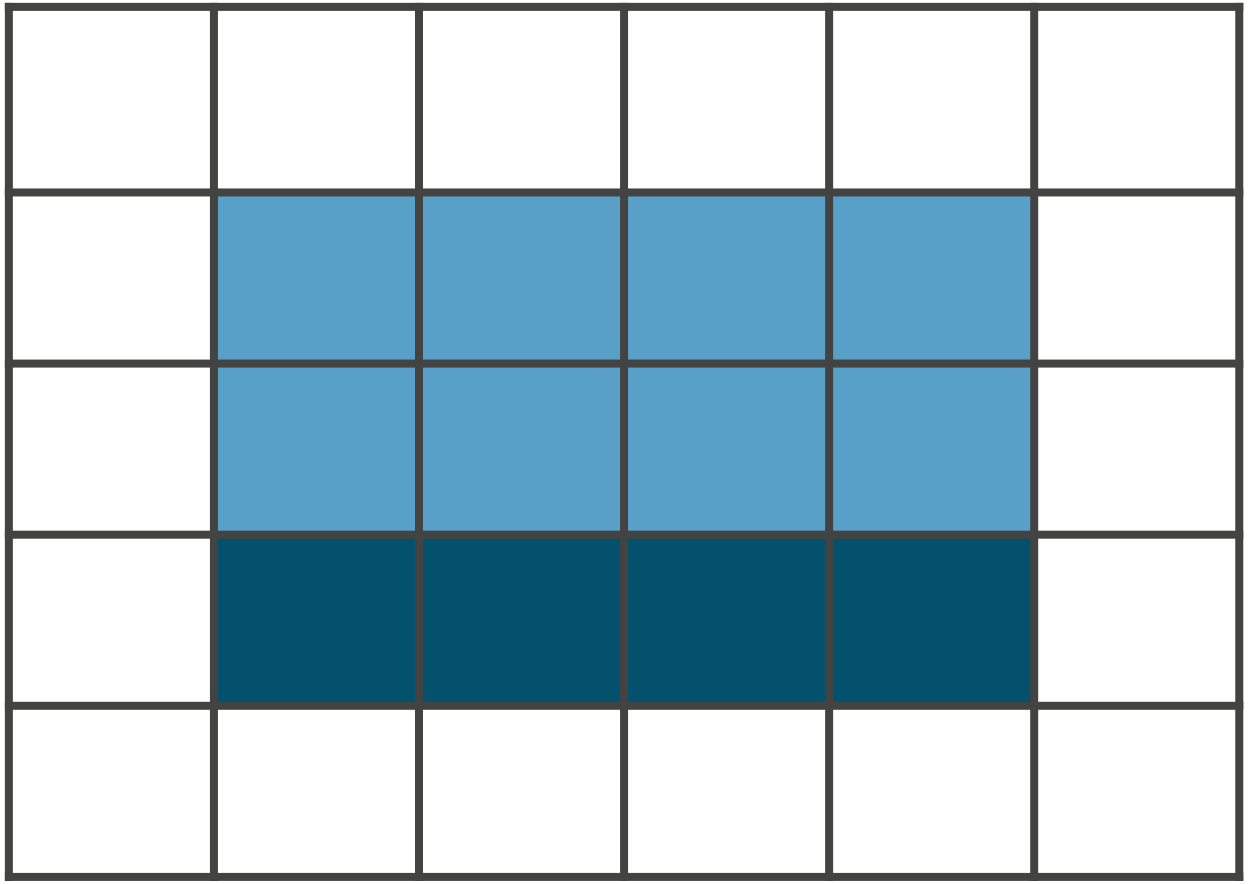
Real Numbers > 0

grayscale

$$I(x, y) : \mathbb{R}^2 \rightarrow \mathbb{R}$$

A Pixel is not a Square*

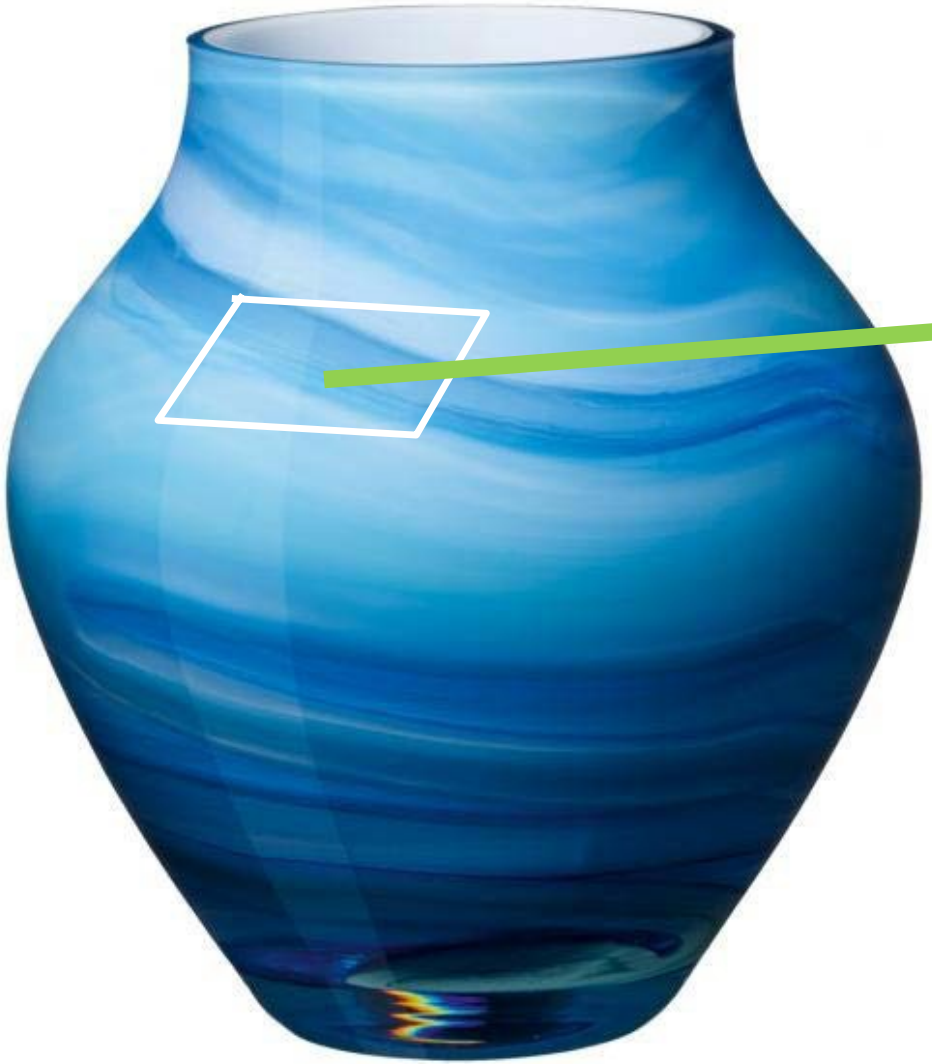
Object



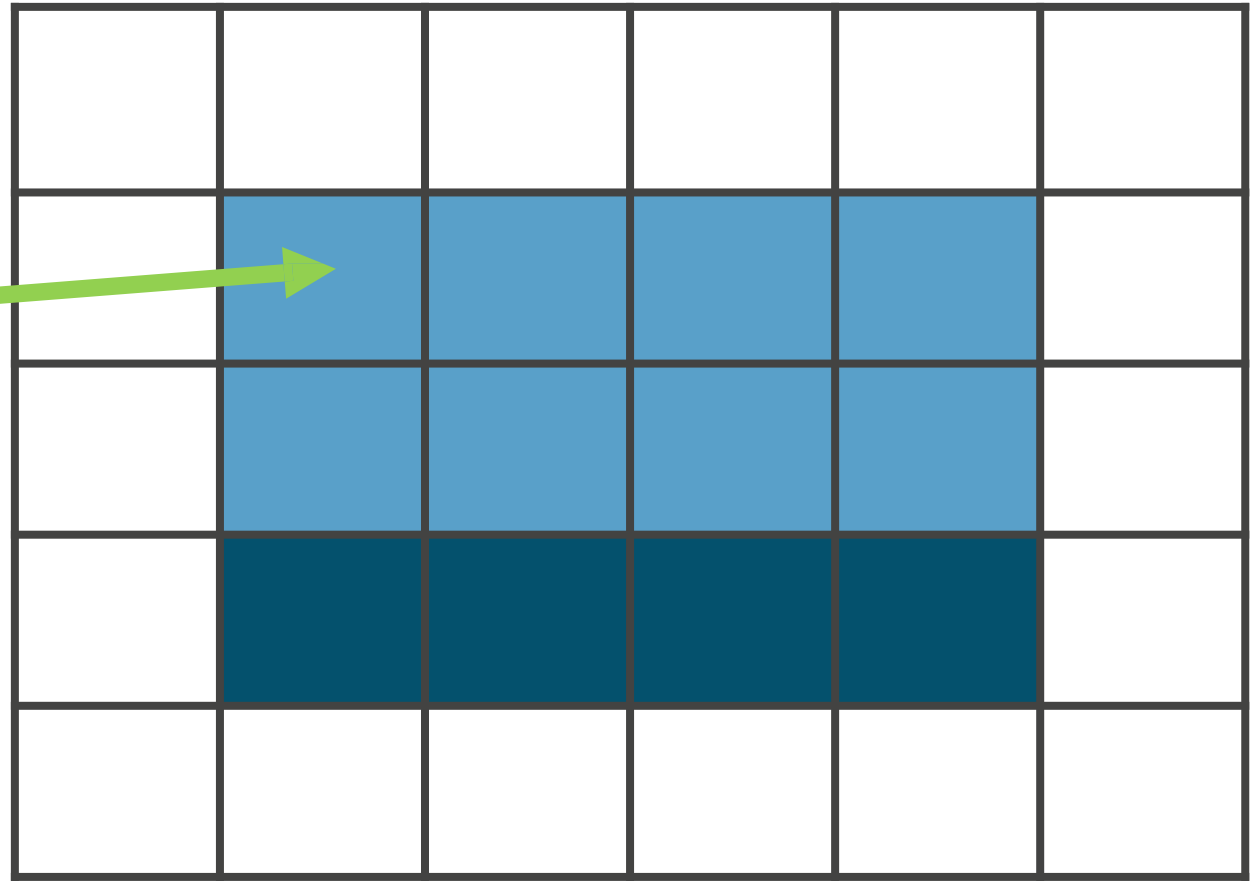
Image

* http://alvyray.com/Memos/CG/Microsoft/6_pixel.pdf

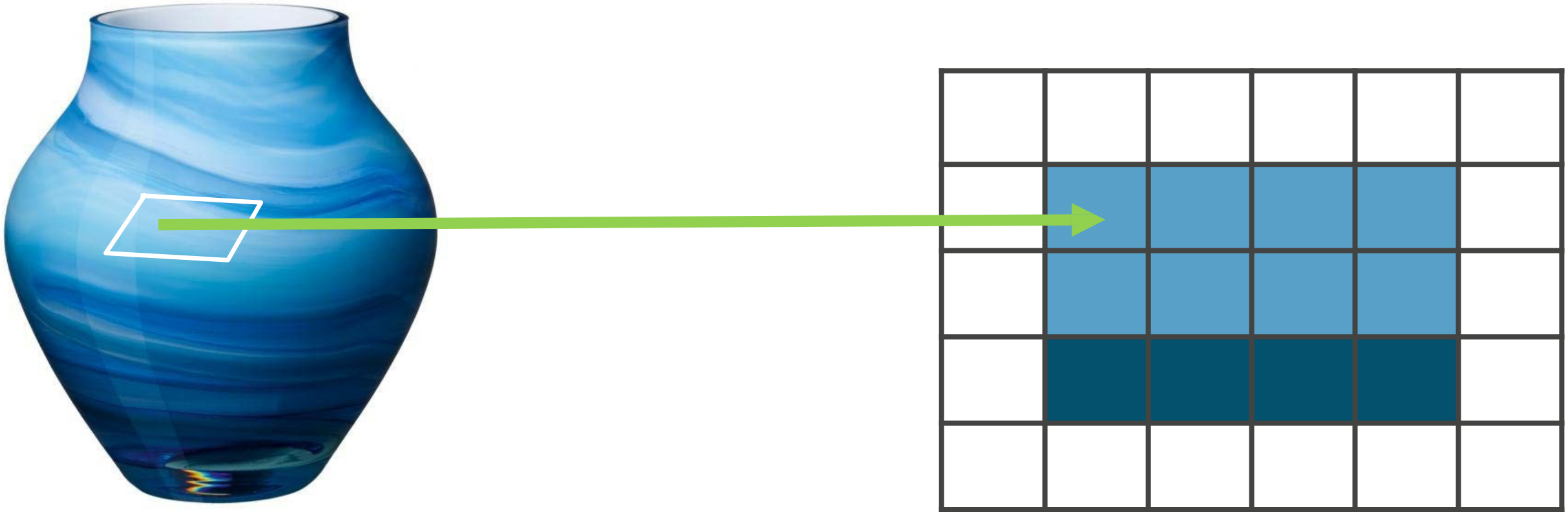
A Pixel is not a Square



Object

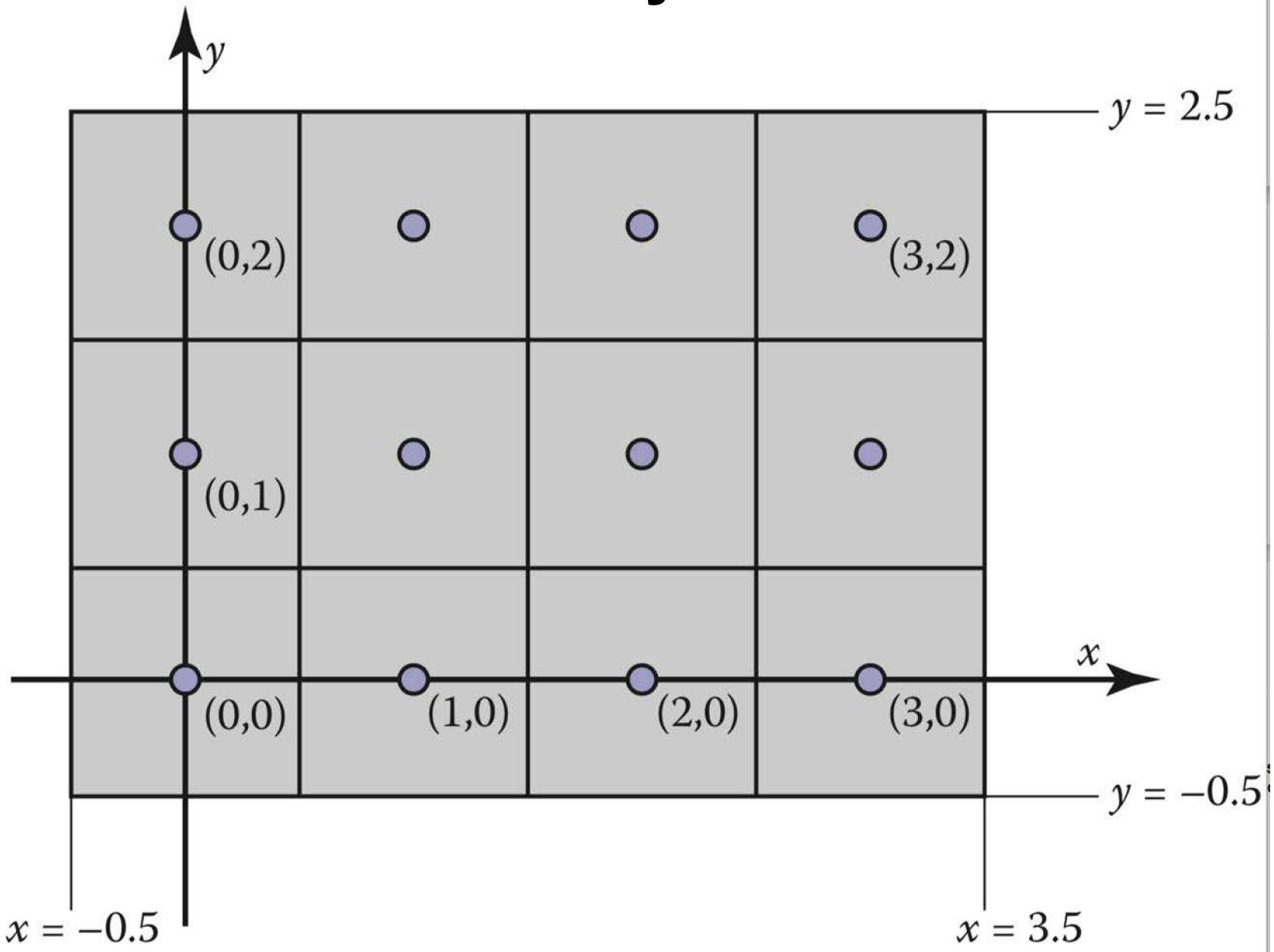


Image



$$\text{colour} = \int_{\text{Area}} \text{Light}\ d\text{Area}$$

Standard Pixel Coordinate System

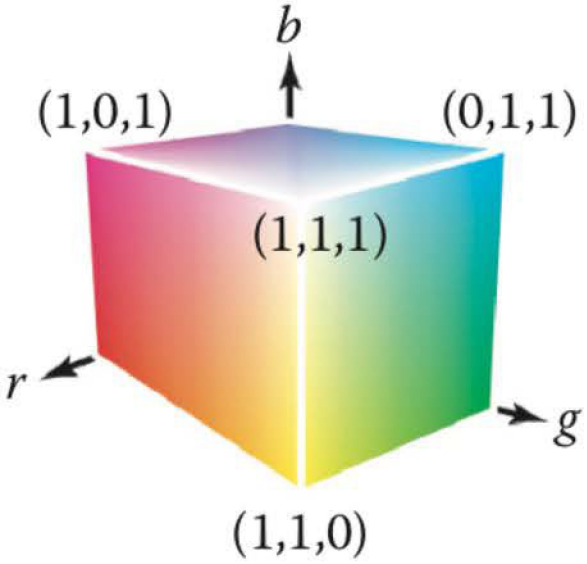


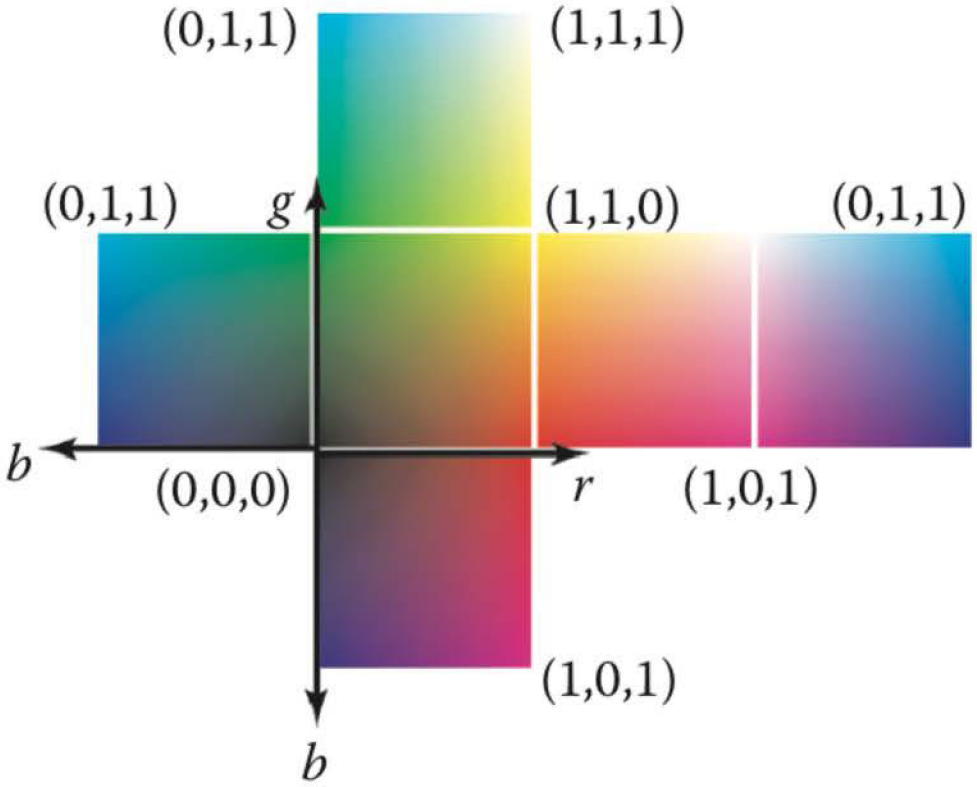
Data Types for Raster Images

Storage for 1024x1024 image (1 megapixel)

- bitmap: 128KB
- grayscale 8bpp: 1MB
- grayscale 16bpp: 2MB
- color 24bpp: 3MB
- floating-point HDR color: 12MB

RGB Images



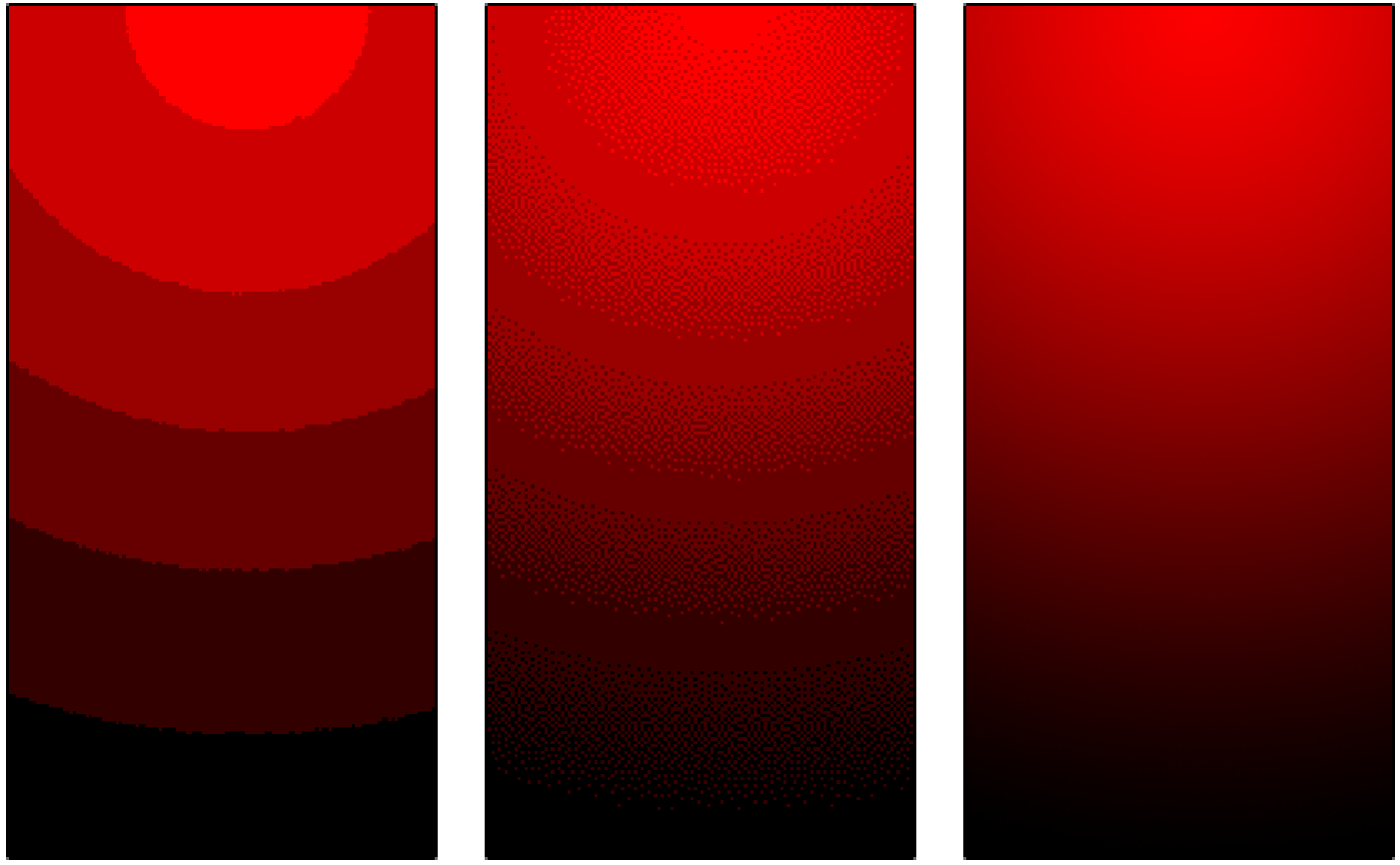


$$\begin{aligned}
\text{black} &= (0, 0, 0), \\
\text{red} &= (1, 0, 0), \\
\text{green} &= (0, 1, 0), \\
\text{blue} &= (0, 0, 1), \\
\text{yellow} &= (1, 1, 0), \\
\text{magenta} &= (1, 0, 1),
\end{aligned}$$

Artifacts of Raster Images: Banding

https://en.wikipedia.org/wiki/Colour_banding

Artifacts of Raster Images: Banding



8-bit gradient

8-bit gradient, dithered

24-bit gradient

https://en.wikipedia.org/wiki/Colour_banding
https://en.wikipedia.org/wiki/Dither#Digital_photography_and_image_processing

Artifacts of Raster Images: Clipping

Original

Clipped

https://en.wikipedia.org/wiki/Clipping_(signal_processing)

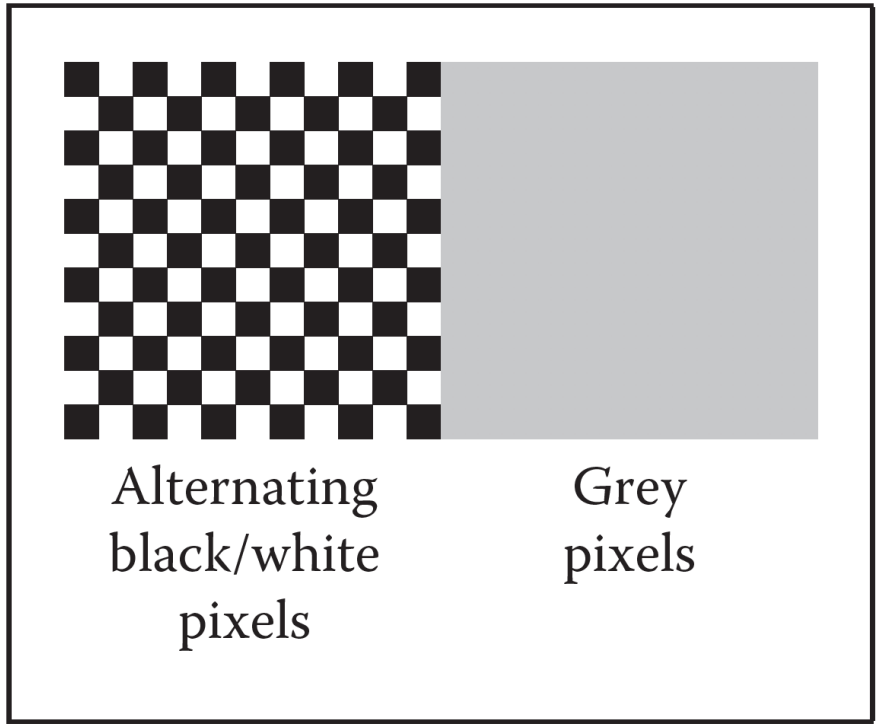
Gamma Correction

Linear encoding V_S =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Linear intensity I =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

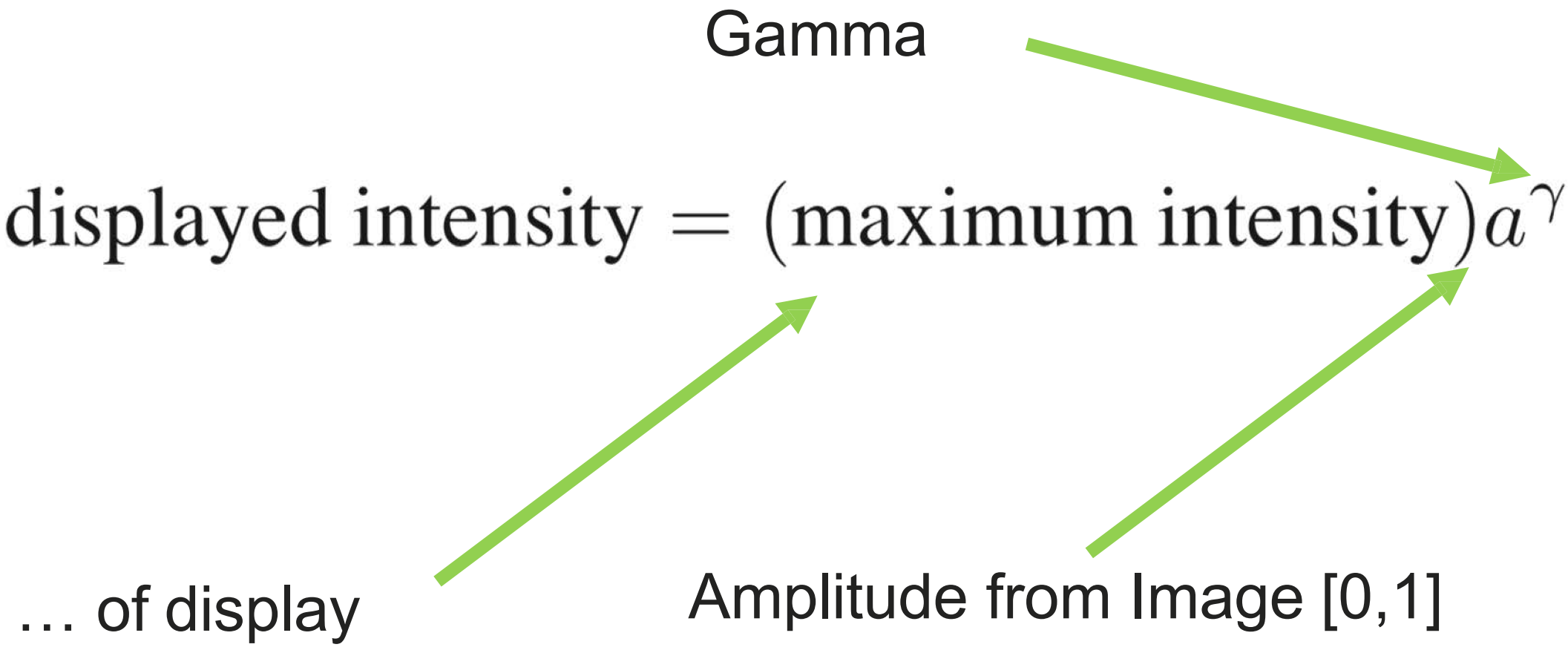
Display intensity is nonlinear wrt input intensity

Gamma Correction

$$\text{displayed intensity} = (\text{maximum intensity})a^{\gamma}$$



Gamma Correction



Gamma Correction

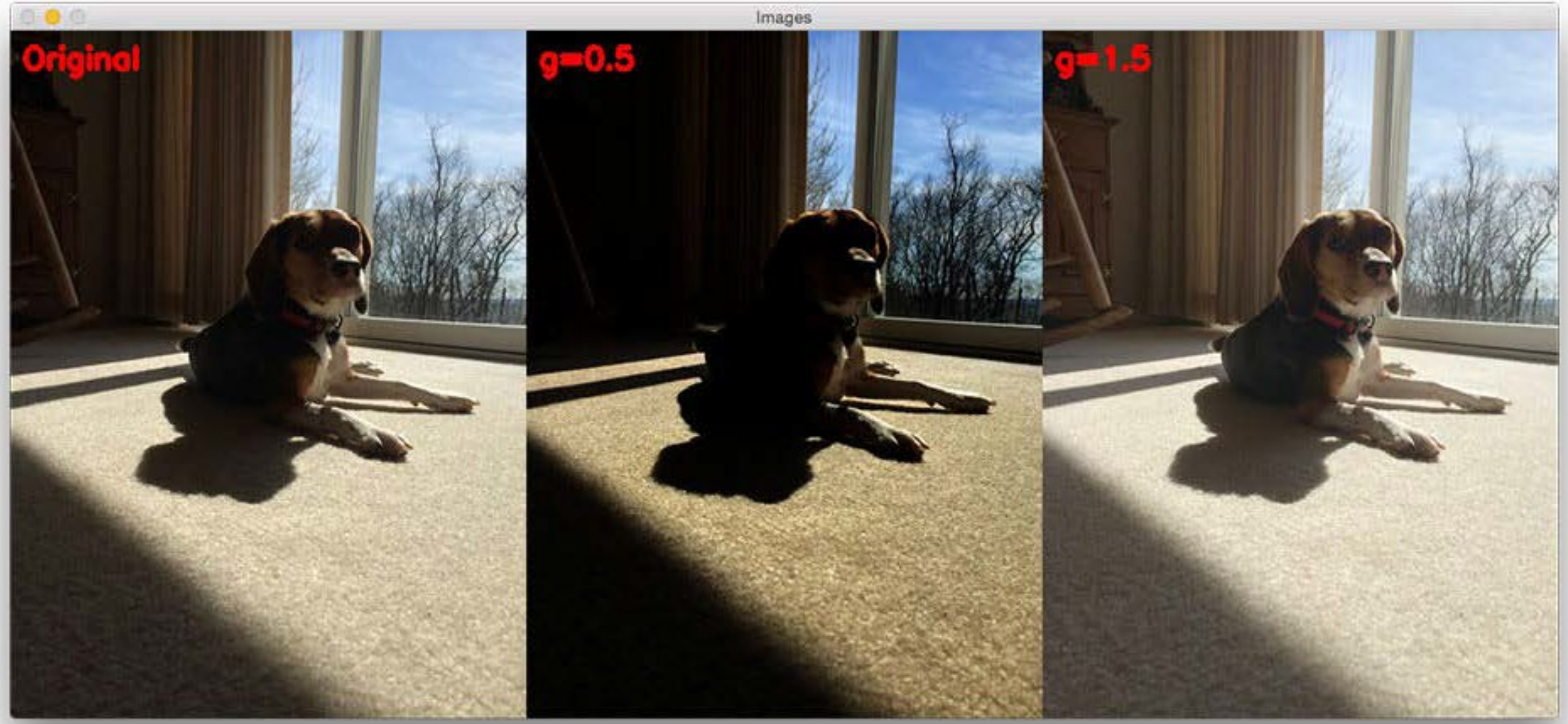
Measure: Find image amplitude that = ½ display brightness

$$0.5 = a^{\gamma}$$

Fit model

$$\gamma = \frac{\ln 0.5}{\ln a}$$

Gamma Correction



Transparency

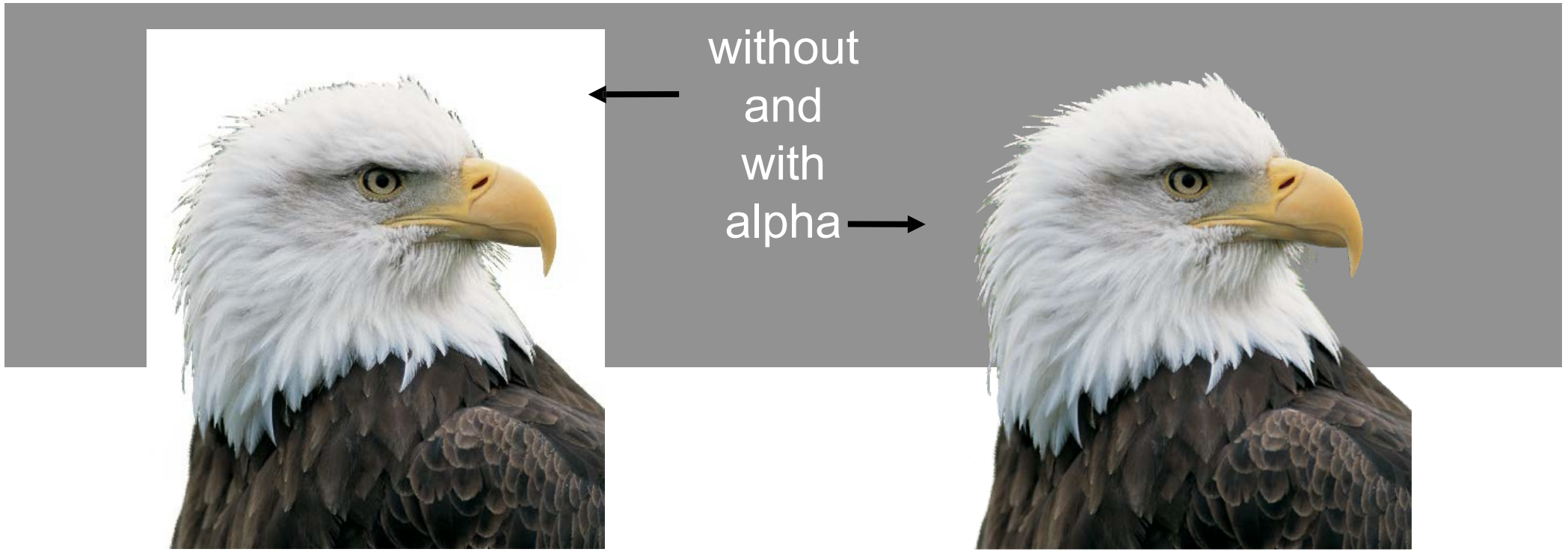
4D Real Numbers > 0

R,G,B,A values

$$I(x, y) : \mathbb{R}^2 \longrightarrow \mathbb{R}^{+4}$$

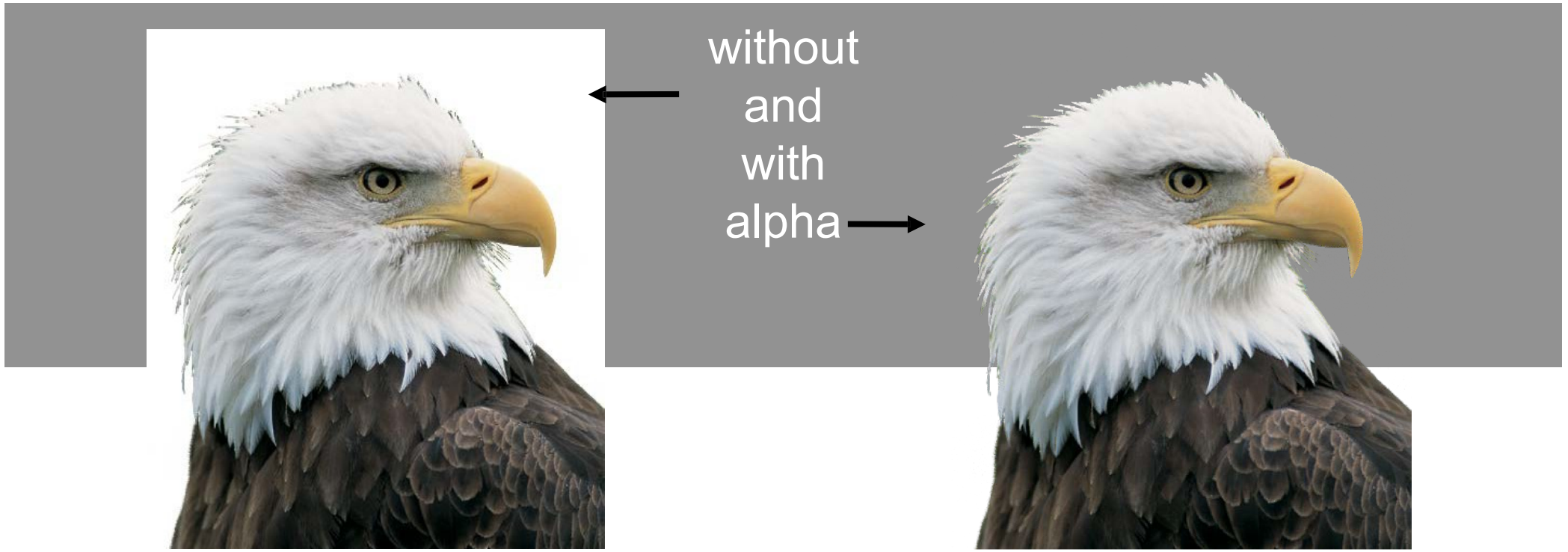
Transparency

Append (Red, Green, Blue) to be (Red, Green, Blue, Alpha)



Transparency

Append (Red, Green, Blue) to be (Red, Green, Blue, Alpha)



$$\mathbf{c} = \alpha \mathbf{c}_f + (1 - \alpha)\mathbf{c}_b$$

Compositing

foreground colour

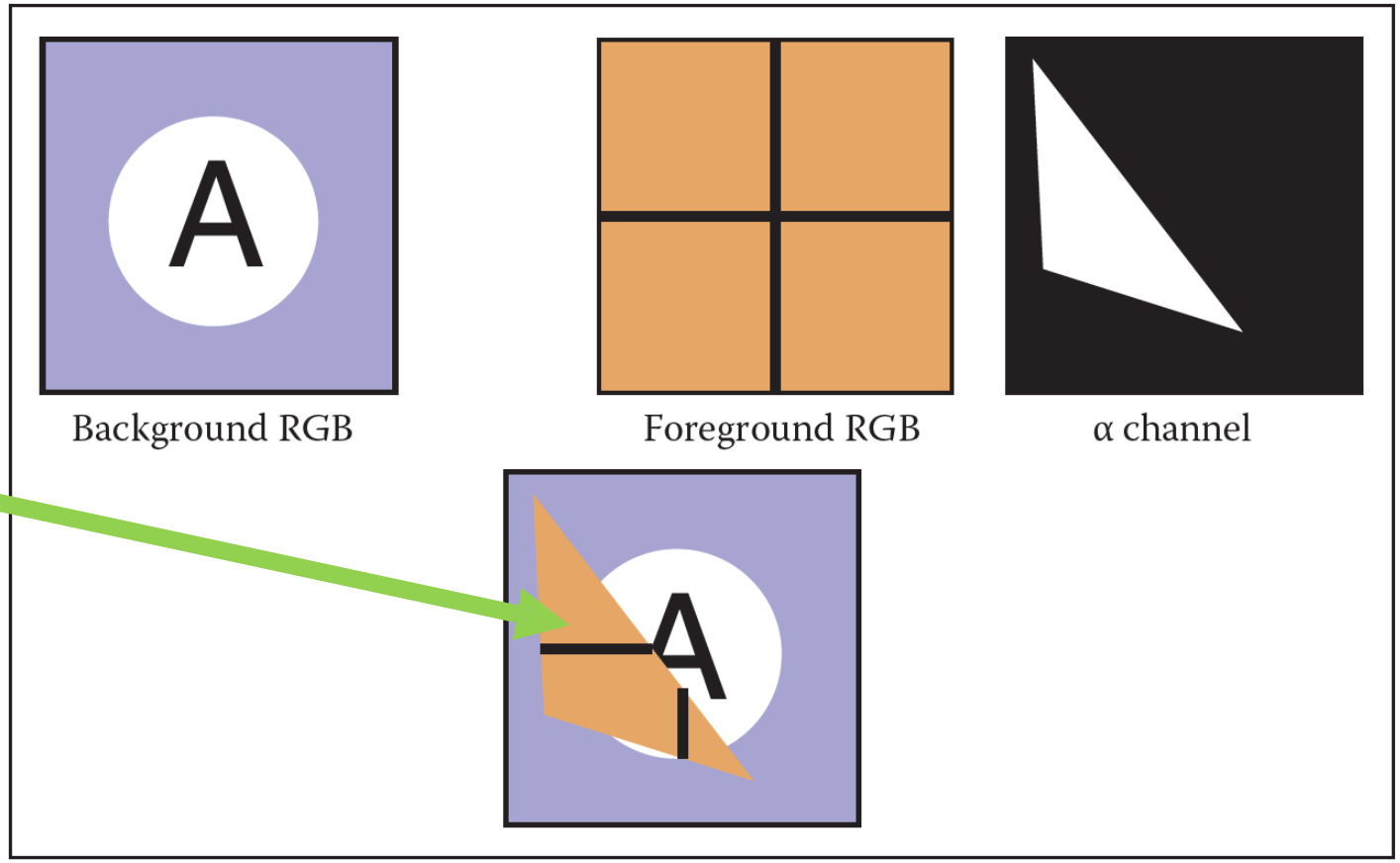
background colour

$$\mathbf{c} = \alpha \mathbf{c}_f + (1 - \alpha)\mathbf{c}_b$$

fraction of pixel coverage

Compositing

$$\mathbf{c} = \alpha \mathbf{c}_f + (1 - \alpha)\mathbf{c}_b$$



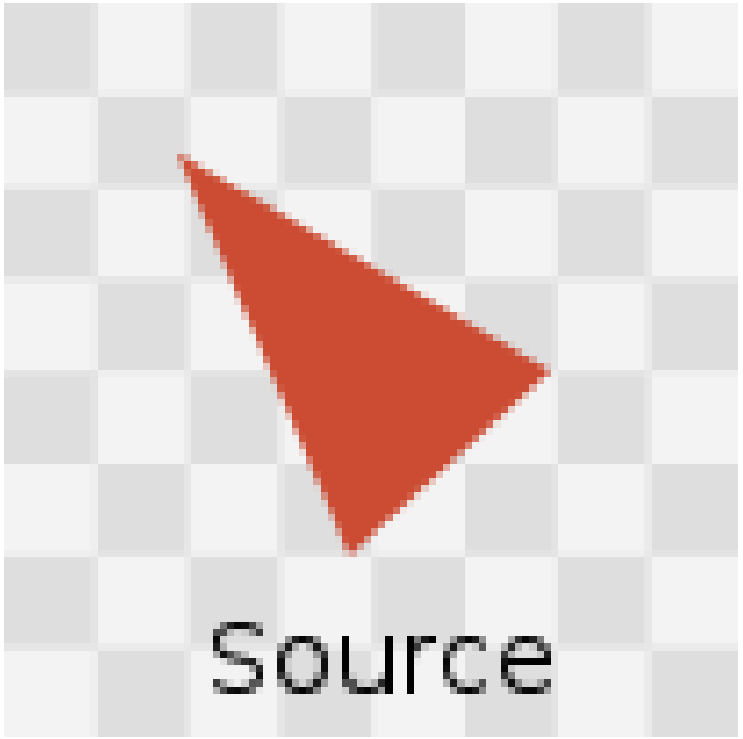
for a pixel here:

$\alpha = 1$

$\mathbf{c} = 1 \cdot \mathbf{c}_f + 0 \cdot \mathbf{c}_b$

Compositing

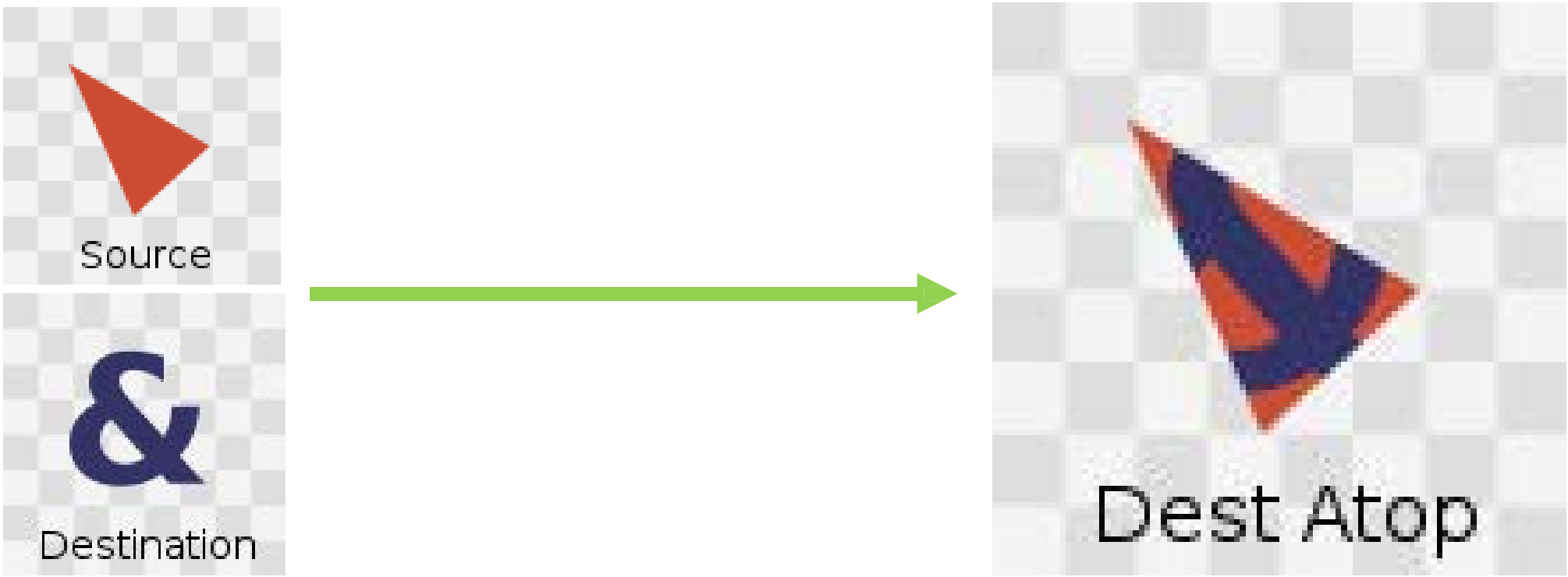
Compositing is about layering images on top of one another



http://ssp.impulsetrain.com/porterduff.html

Compositing

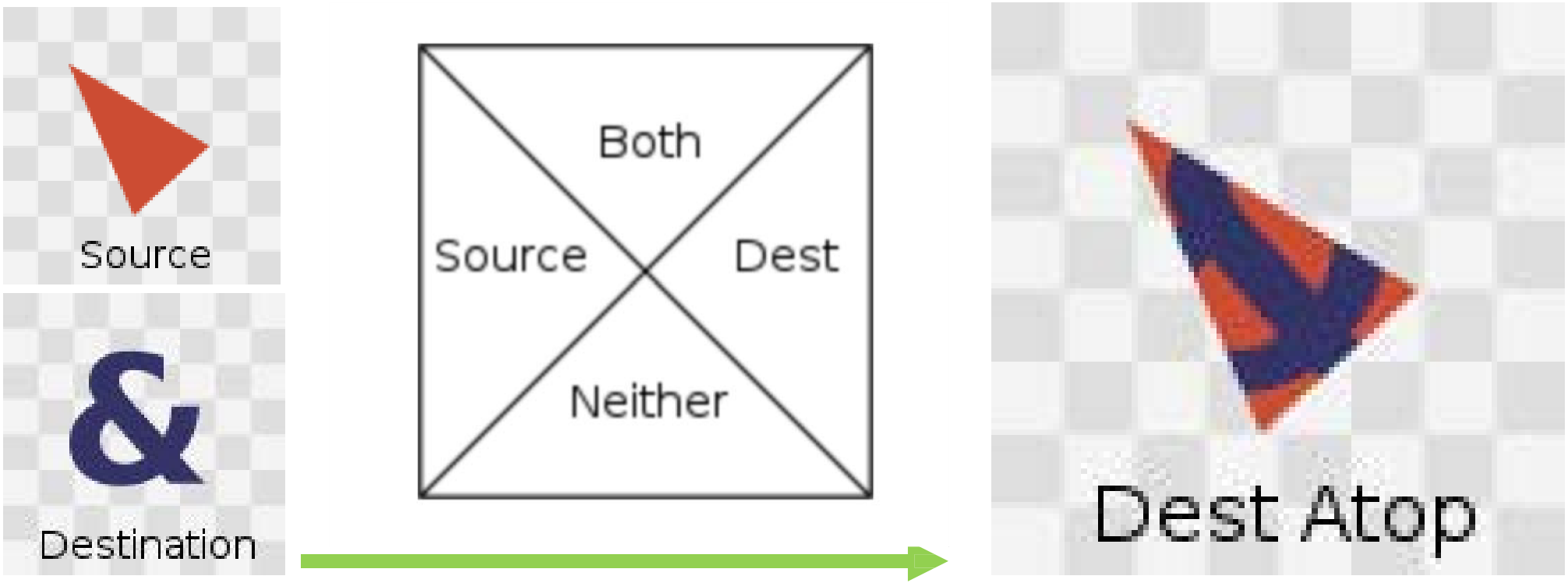
Compositing is about layering images on top of one another



http://ssp.impulsetrain.com/porterduff.html

Compositing

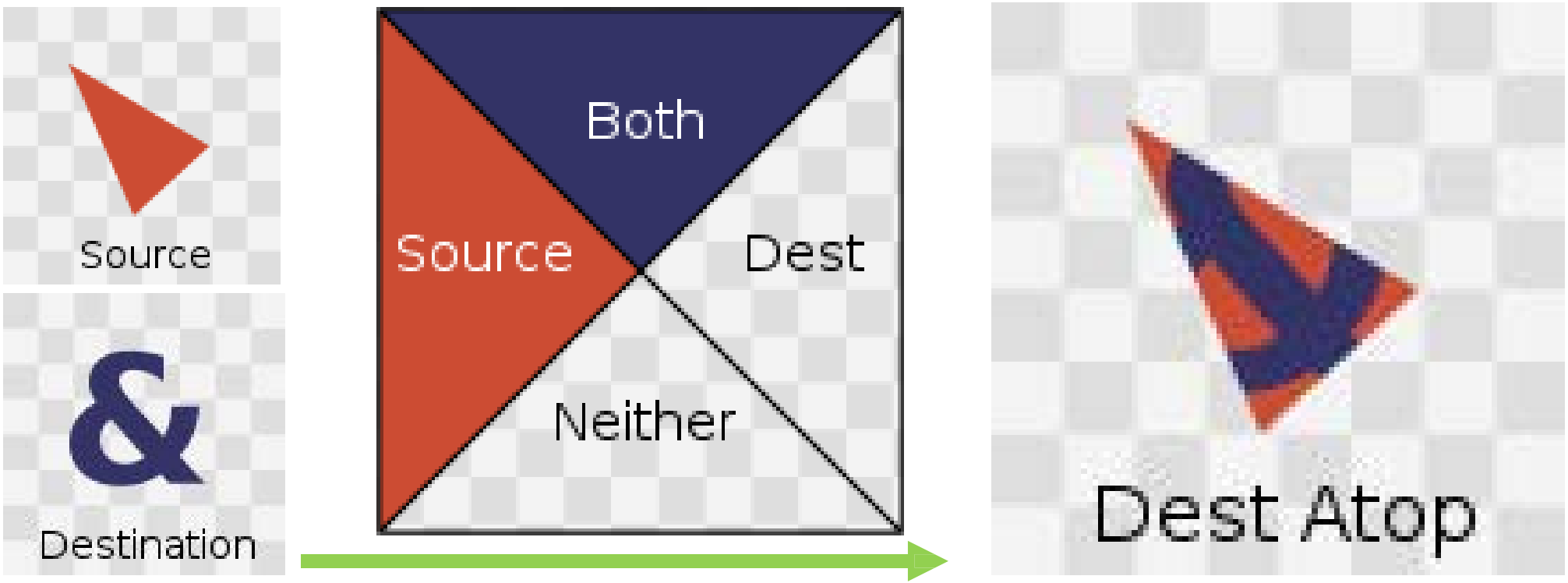
Compositing is about layering images on top of one another



http://ssp.impulsetrain.com/porterduff.html

Compositing

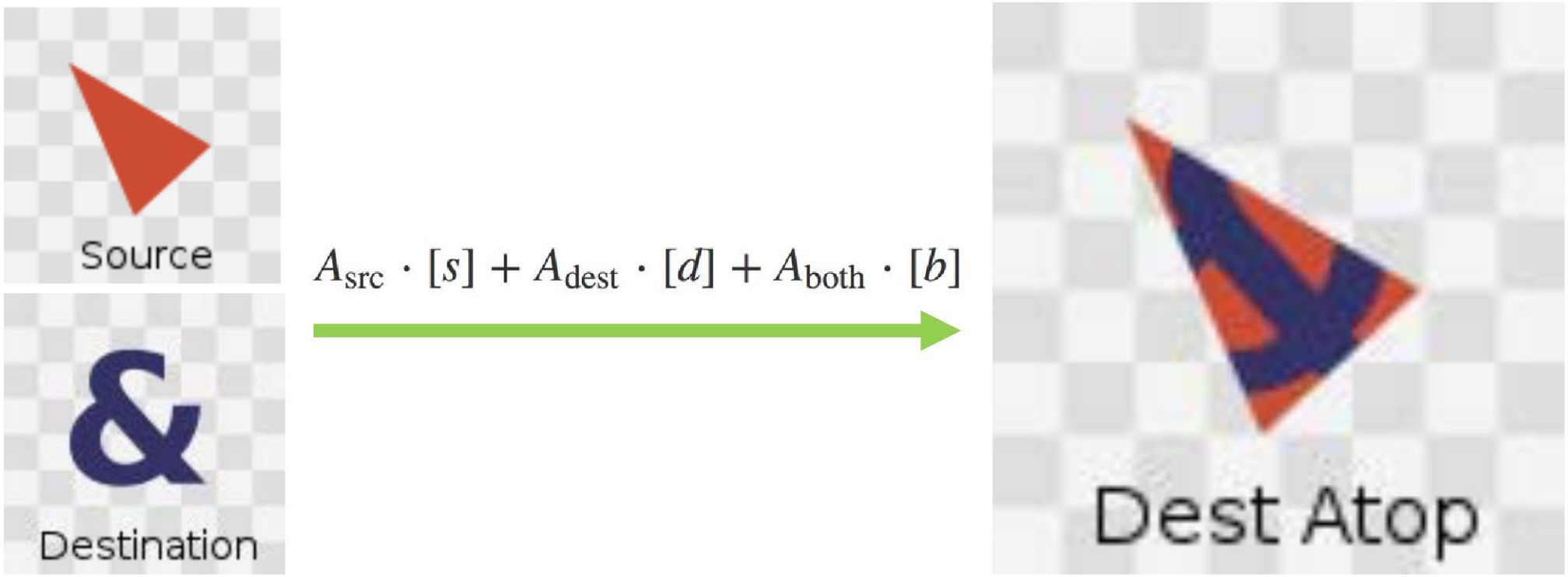
Compositing is about layering images on top of one another



http://ssp.impulsetrain.com/porterduff.html

Compositing

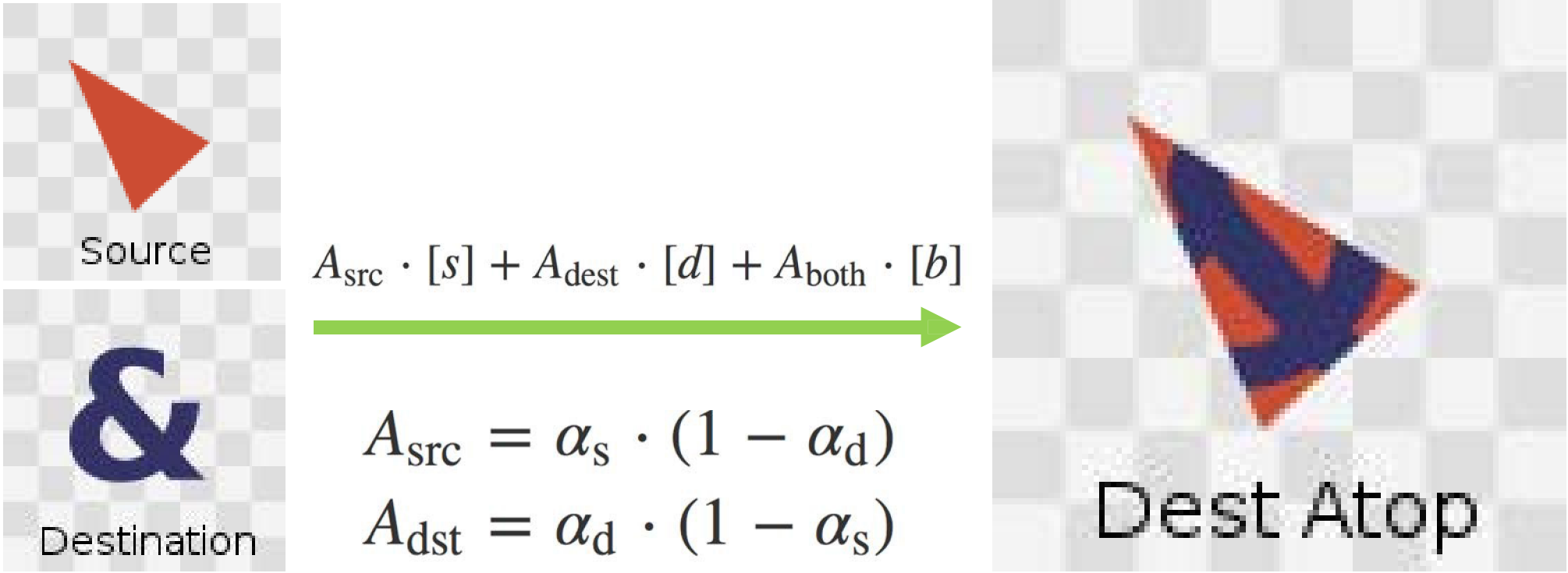
Compositing is about layering images on top of one another



http://ssp.impulsetrain.com/porterduff.html

Compositing

Compositing is about layering images on top of one another



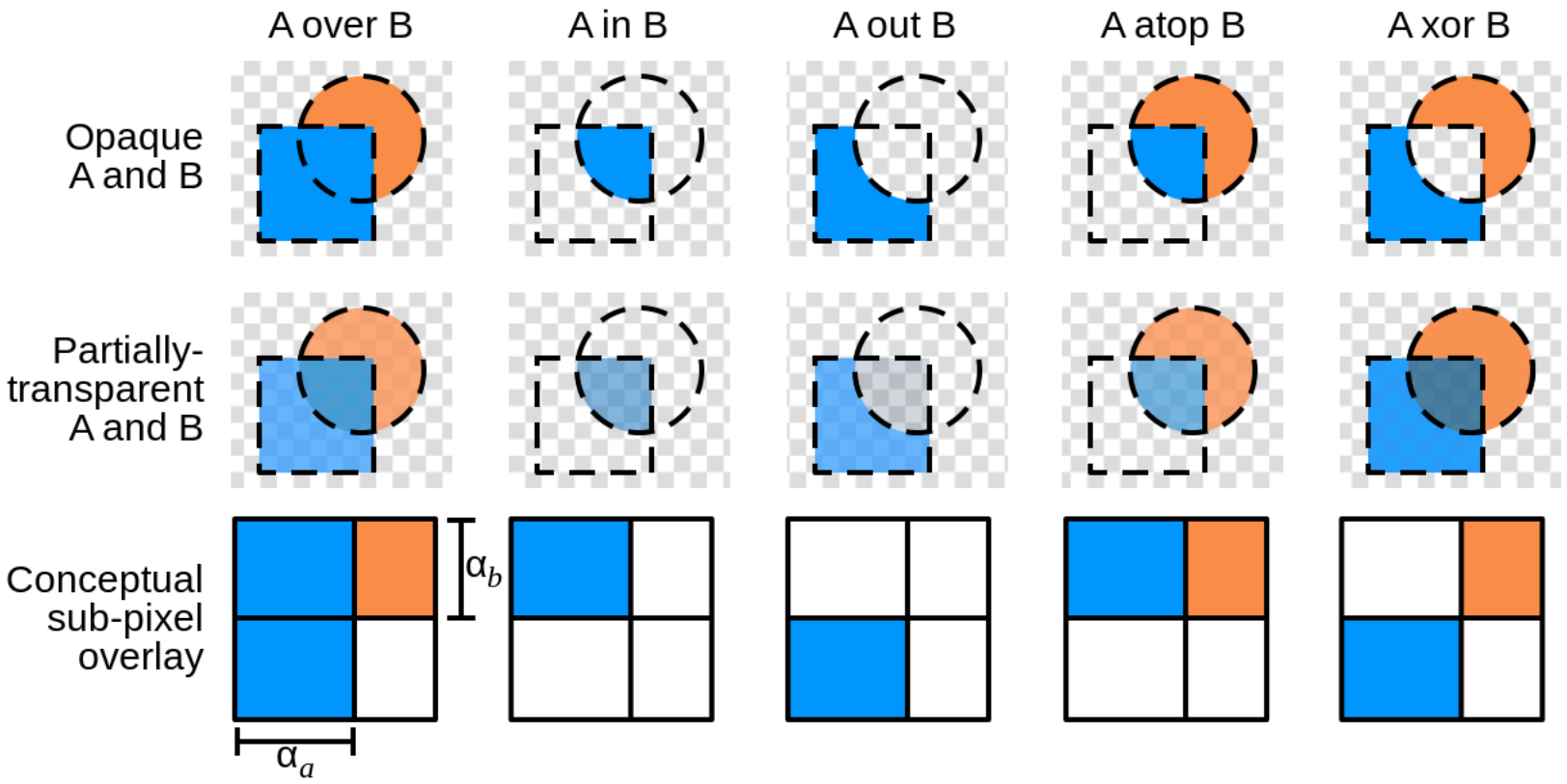
http://ssp.impulsetrain.com/porterduff.html

Other Operators

	[s]	[d]	[b]
Src	*s*	0	s
Atop	0	*d*	s
Over	*s*	*d*	s
In	0	0	s
Out	*s*	0	0
Dest	0	*d*	d
DestAtop	*s*	0	d
DestOver	*s*	*d*	d
DestIn	0	0	d
DestOut	0	*d*	0
Clear	0	0	0
Xor	*s*	*d*	0

https://en.wikipedia.org/wiki/Alpha_compositing

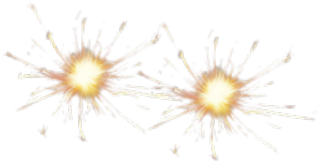
Other Operators



https://en.wikipedia.org/wiki/Alpha_compositing

Compositing

Compositing is about layering images on top of one another



over

over

=

Next Week: Ray Casting

How assignments work