

Perception, Representation, & Manipulation of Visual Information

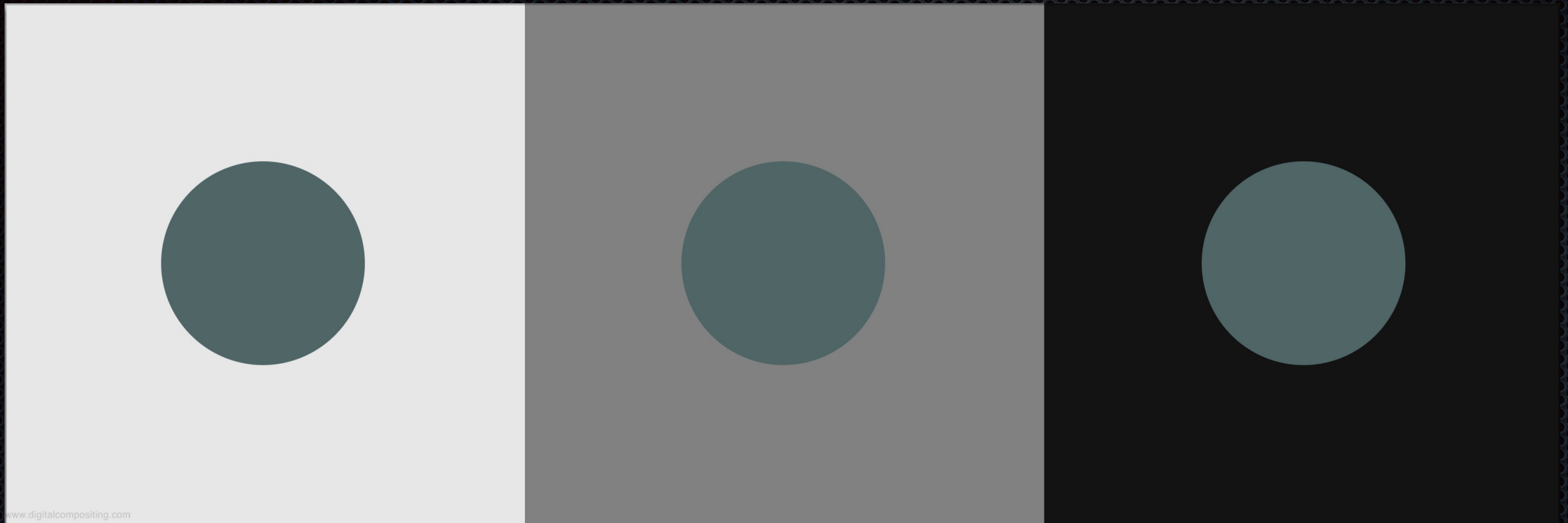
Brinkmann's Art and Science of Compositing

(Ch. 2-5, 8, 9, 11).

I see no more than you, but I have
trained myself to notice what I see.

Sherlock Holmes in Arthur Conan Doyle's
The Adventure of the Blanched Soldier

Perception



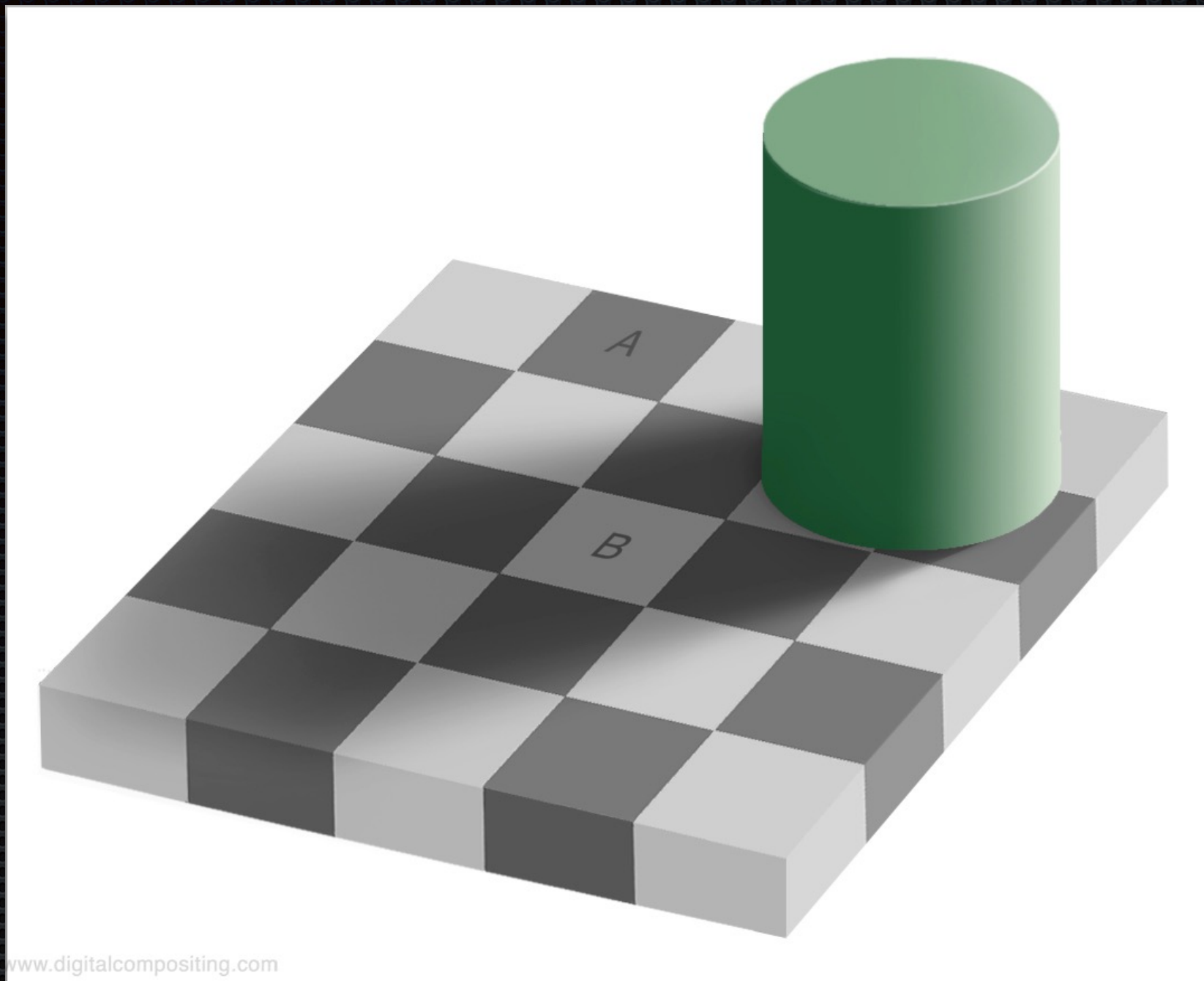
Perception

affects our interpretation of *brightness* and *contrast*.



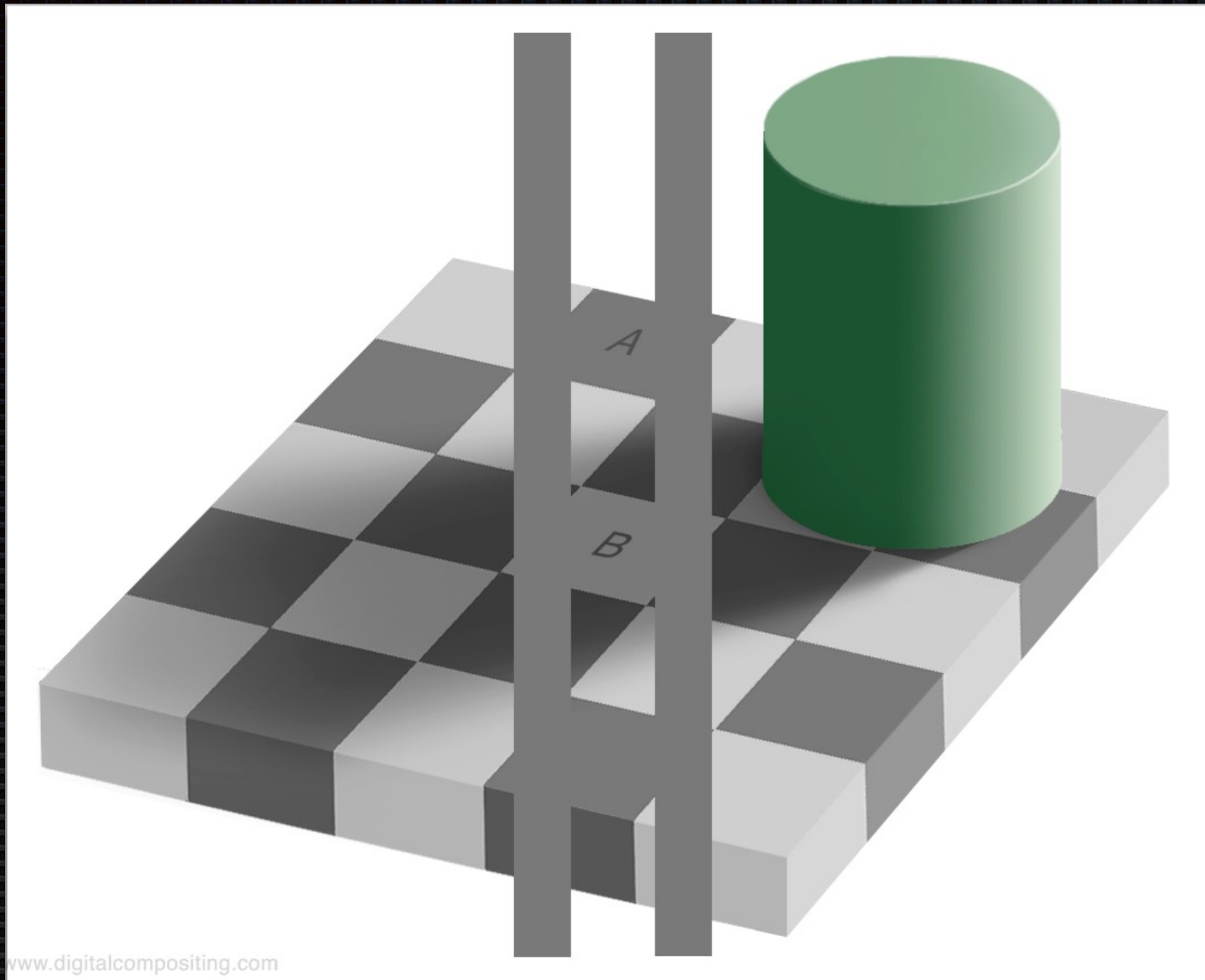
Perception

affects our interpretation of *color*.



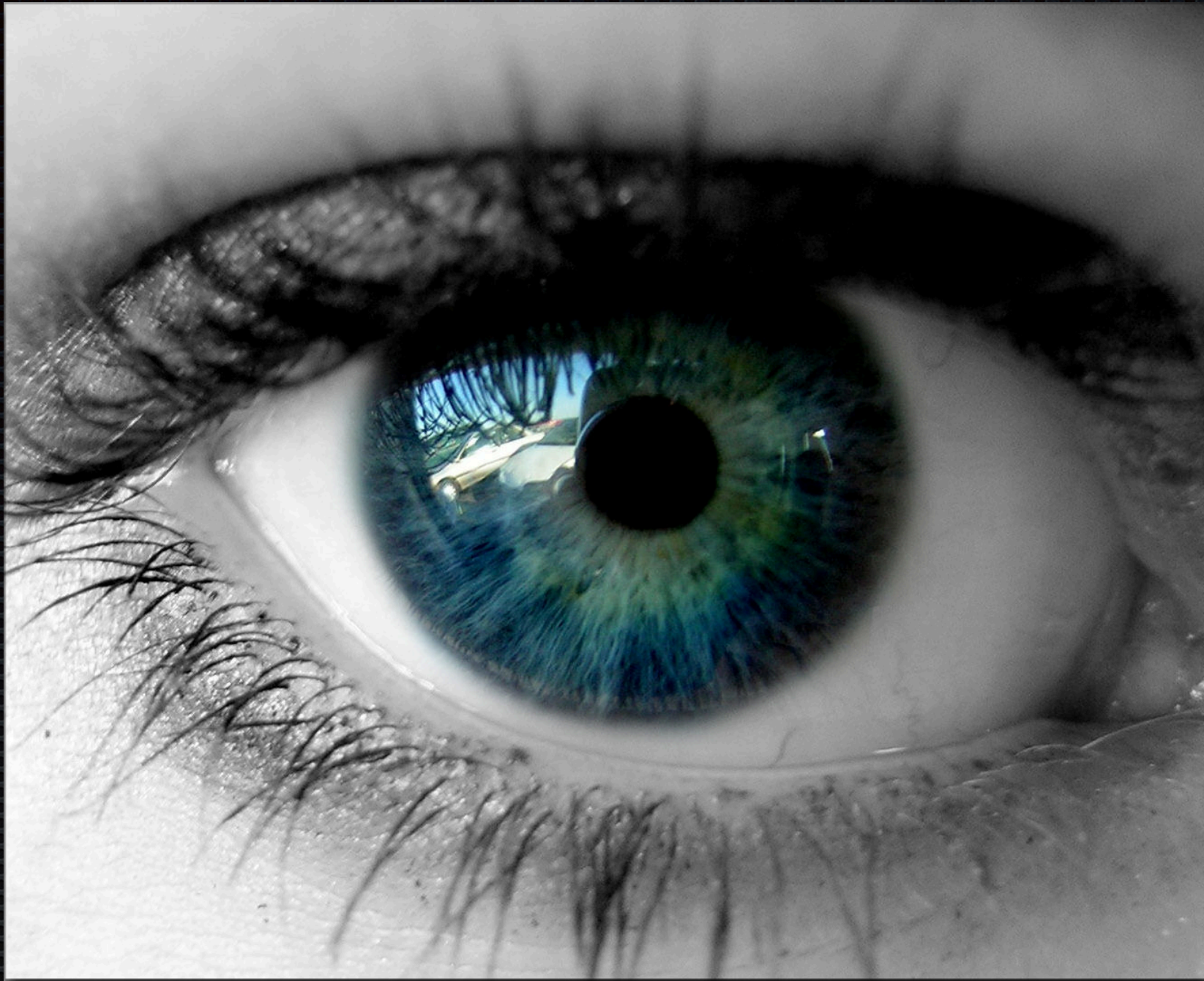
Perception

affects our interpretation of *brightness* and *contrast*.

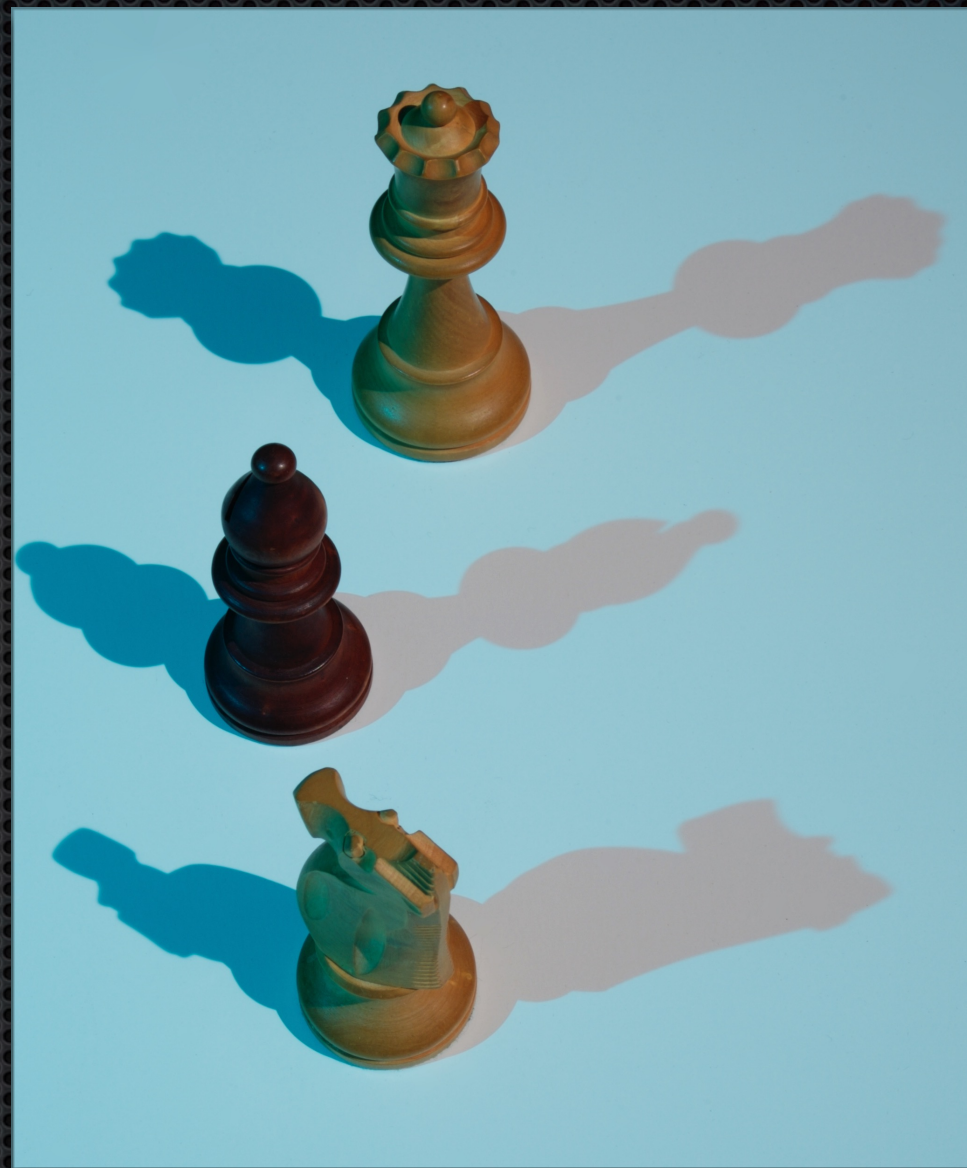


Perception

affects our interpretation of *brightness* and *contrast*.



Human Visual System
should be considered during our work.



Light and Shadow



Light and Shadow



Light and Shadow

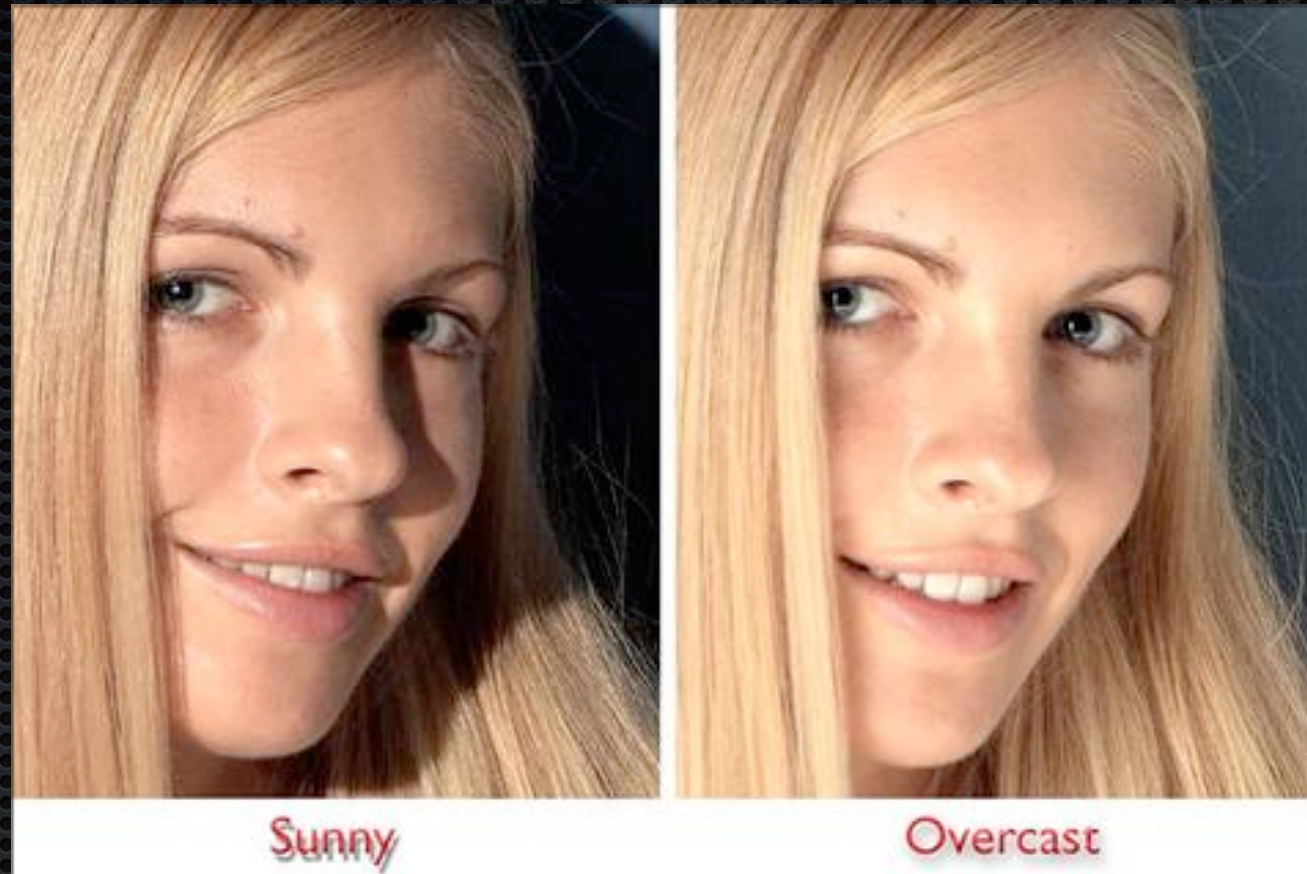


Light and Shadow



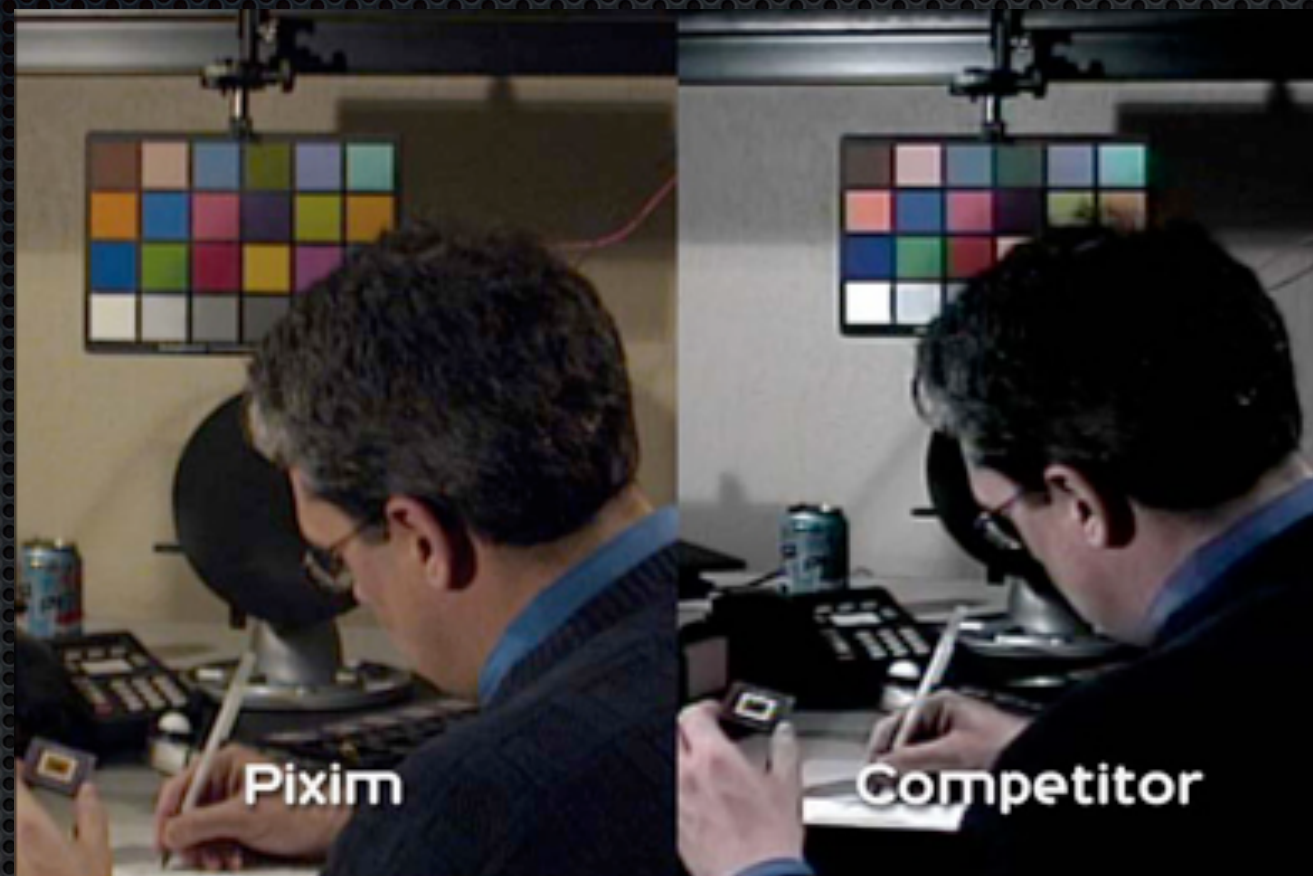
Light and Shadow

High-key and low-key lighting and exposure.



Light and Shadow

“Soft” and “hard” light; diffuse and specular.



Light and Shadow

Color Temperature



Lighting & Materials

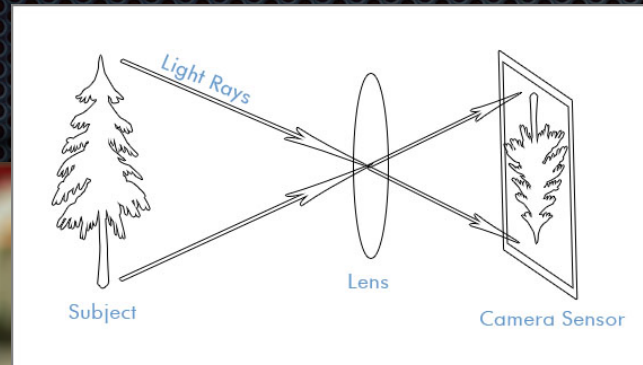
Bi-directional Reflectance Distribution Function.



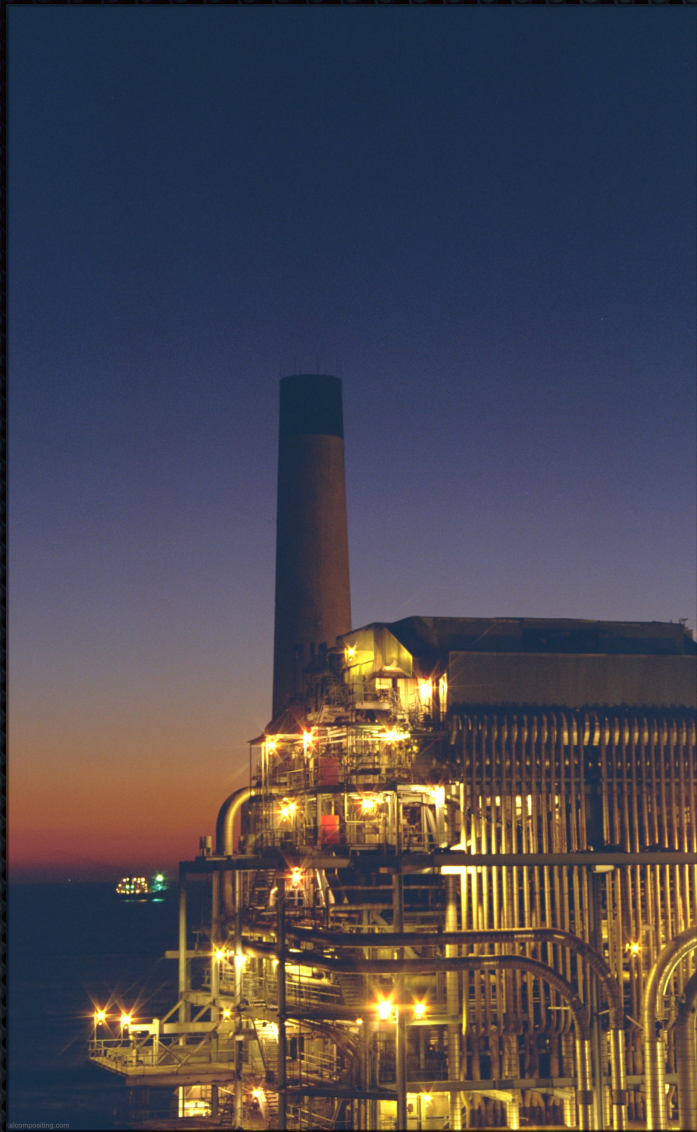
Light and Contrast

Representation

Properties of cameras & displays.



Pinholes and Lenses and Rays



Focus

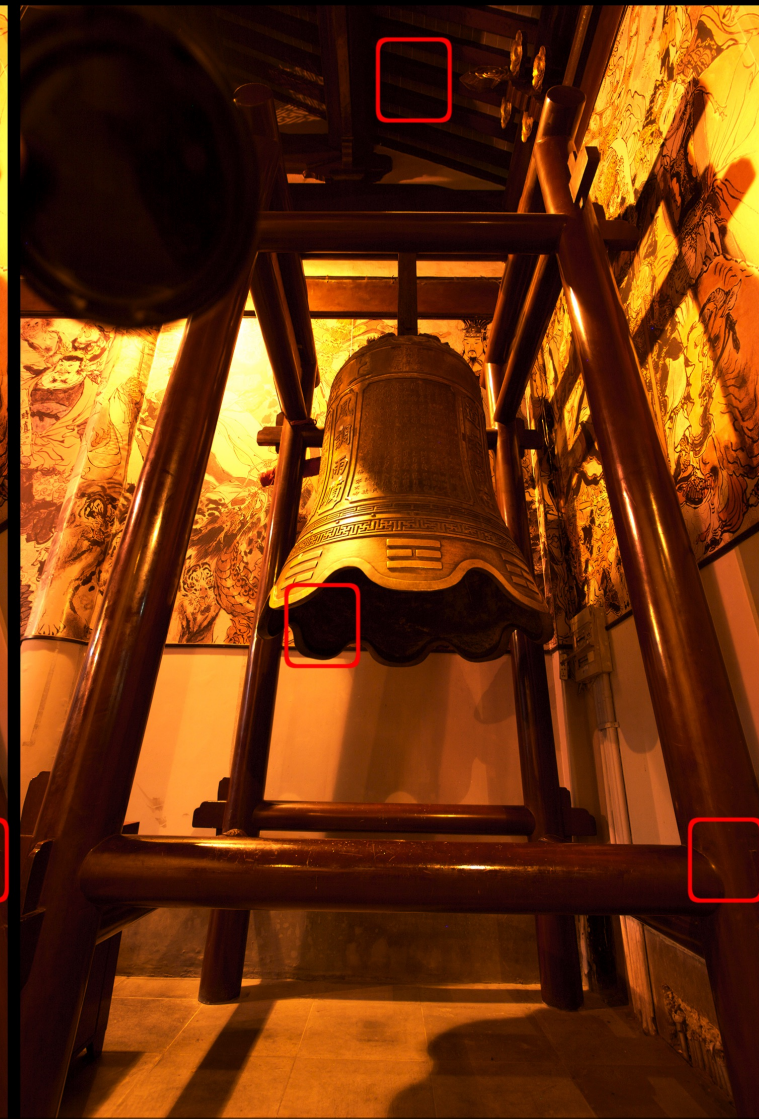
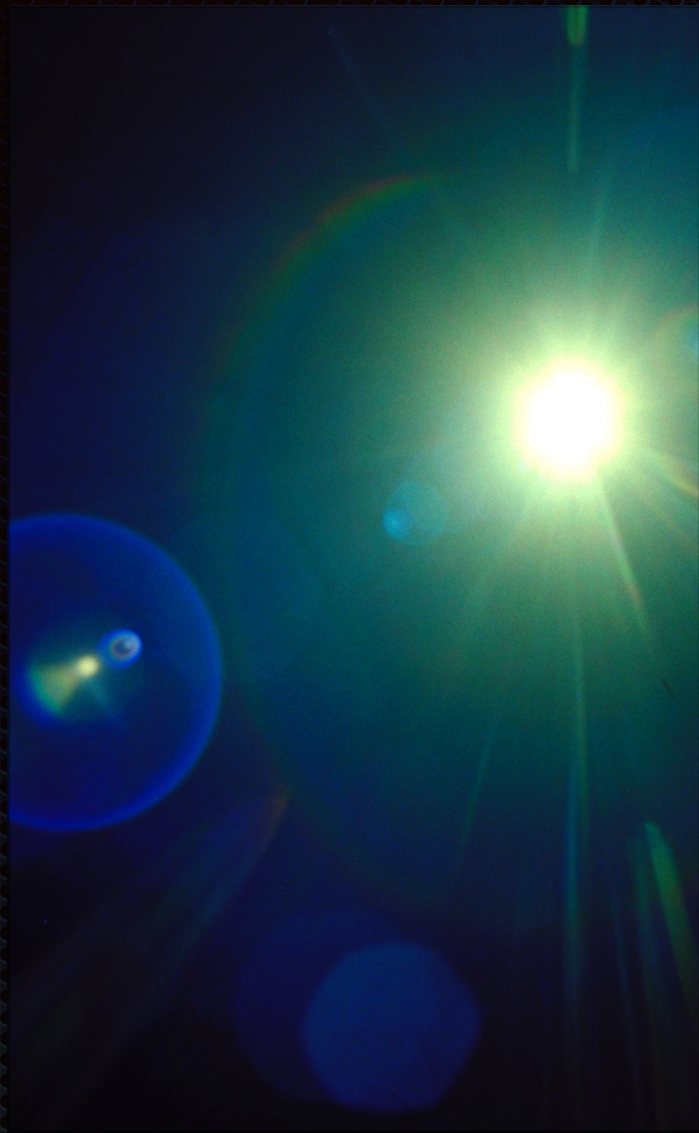
f/5.6

f/8

f/22



Depth of Field



Flare





Distortion
Barrel and Pincushioning





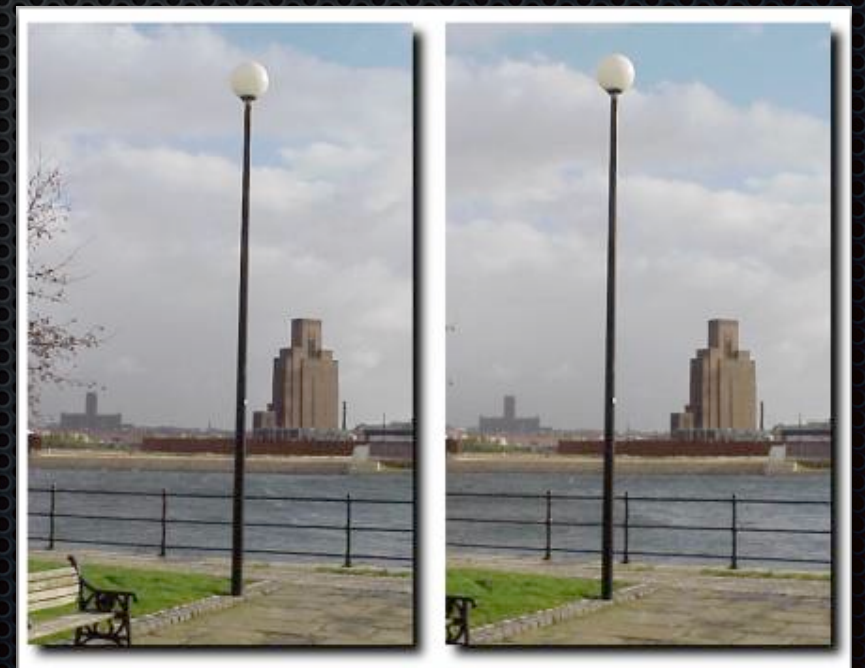
Focal Length

Use, effects,
and distortion.

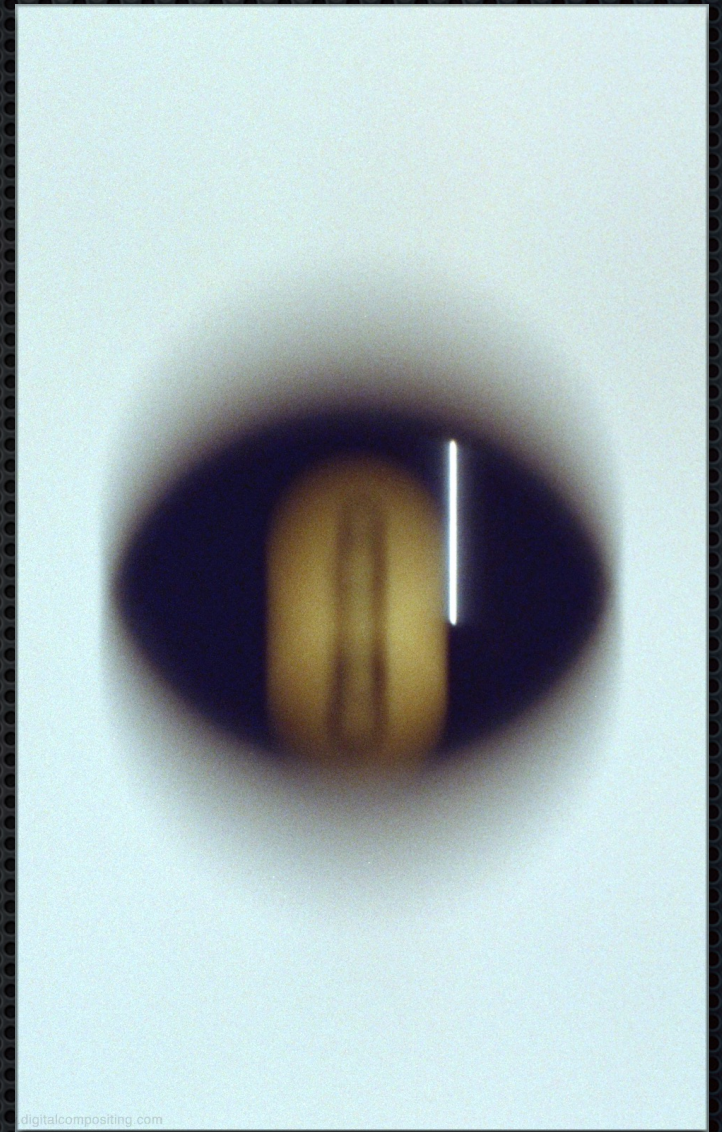




Perspective & Parallax







Motion Blur



Atmospheric Effects



Stereoscopy



Stereoscopy

4K - 2304 x 4096

2K - 1152 x 2048

1080p - 1080 x 1920

720p - 720 x 1280

DV - 480 x 720



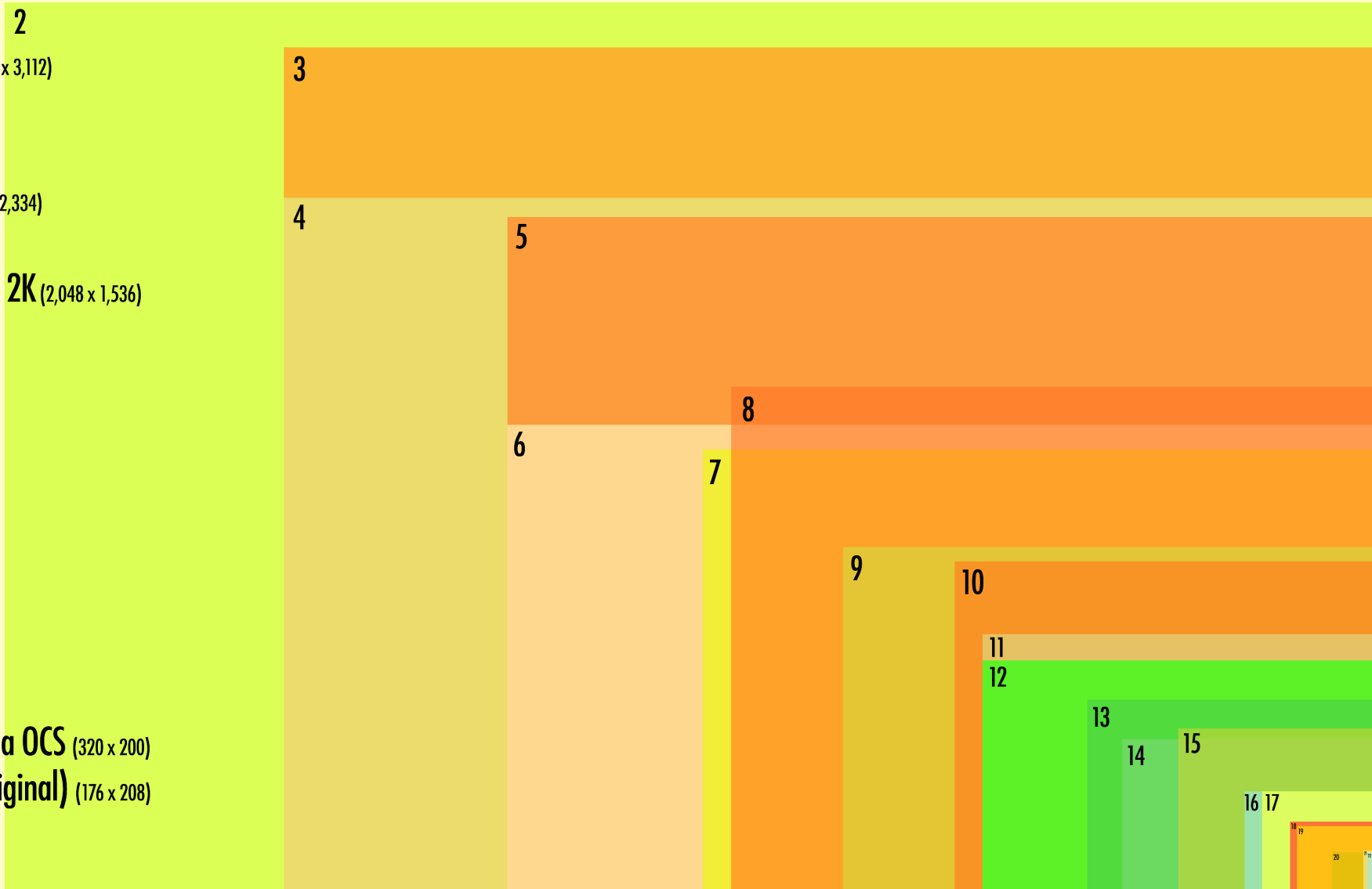
Capture Resolution



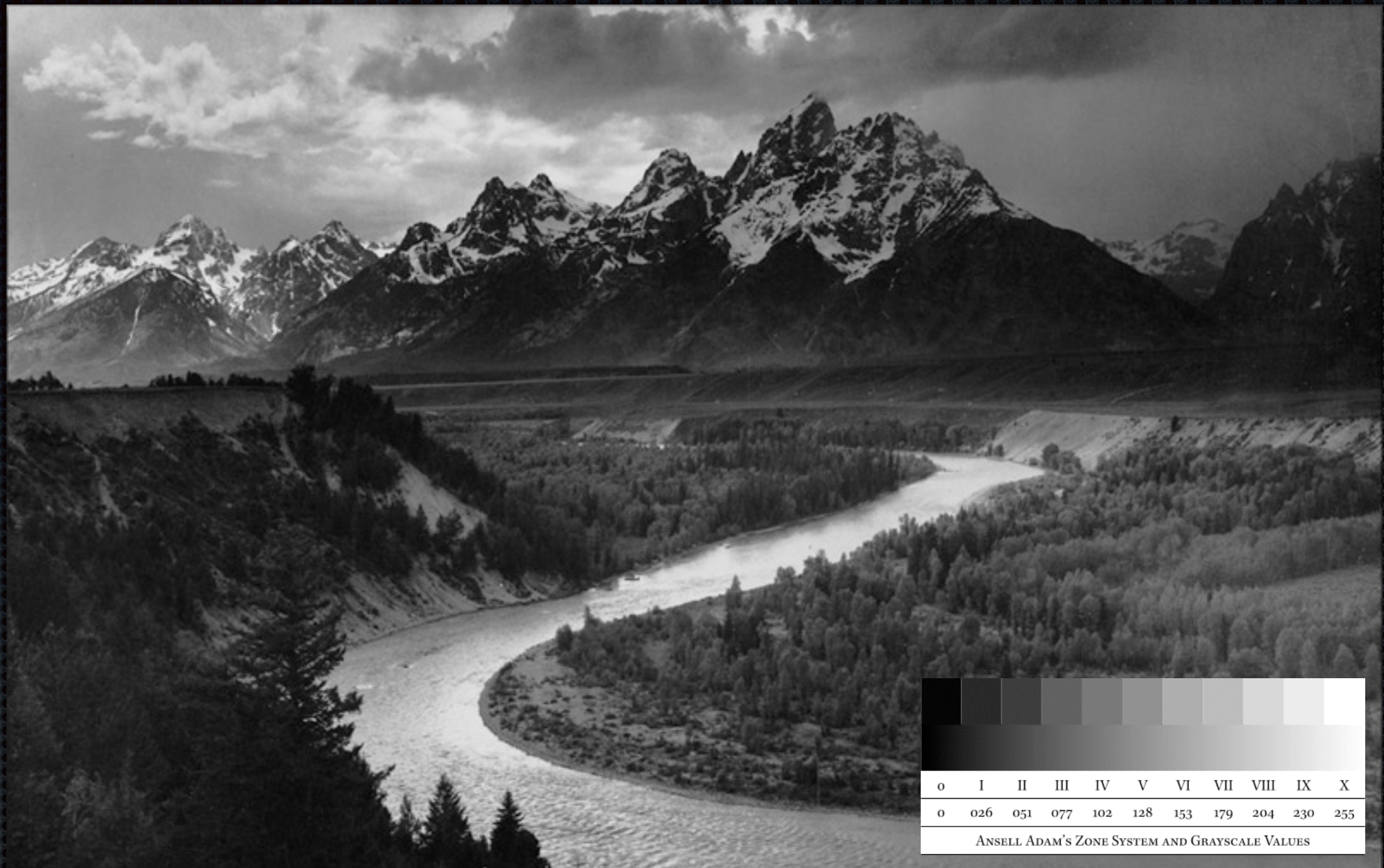
Capture Resolution

1. WHUXGA (7,680 x 4,800)
2. WHSXGA (6,400 x 4,096)
3. 5K (estimated) (5,120 x 3,890)
4. WHXGA (5,120 x 3,200)
5. Full Aperture 4K (4,096 x 3,112)
6. Sony 4K (4,096 x 2,160)
7. WQXGA (3,200 x 2,048)
8. 3K (estimated) (3,072 x 2,334)
9. WQXGA (2,560 x 1,600)
10. Full Aperture Native 2K (2,048 x 1,536)
11. WUXGA (1,920 x 1,200)
12. 1080p (1,920 x 1,080)
13. WXGA+ (1,440 x 900)
14. 720p (1,280 x 720)
15. XGA (1,024 x 768)
16. DVD (NTSC) (768 x 480)
17. VGA (640 x 480)
18. Macintosh (512 x 342)
19. iPhone (480 x 320)
20. CGA/Atari ST/Amiga OCS (320 x 200)
21. Nokia Series 60 (Original) (176 x 208)
22. IBM PCjr (160 x 200)

<http://gadgets.boingboing.net>



Display Resolution



Latitude

Both capture and display devices have a finite *dynamic range* of light representation.



Latitude

Both capture and display devices have a finite *dynamic range* of light representation.

Scientific Visualization:

It needs to be *correct*.

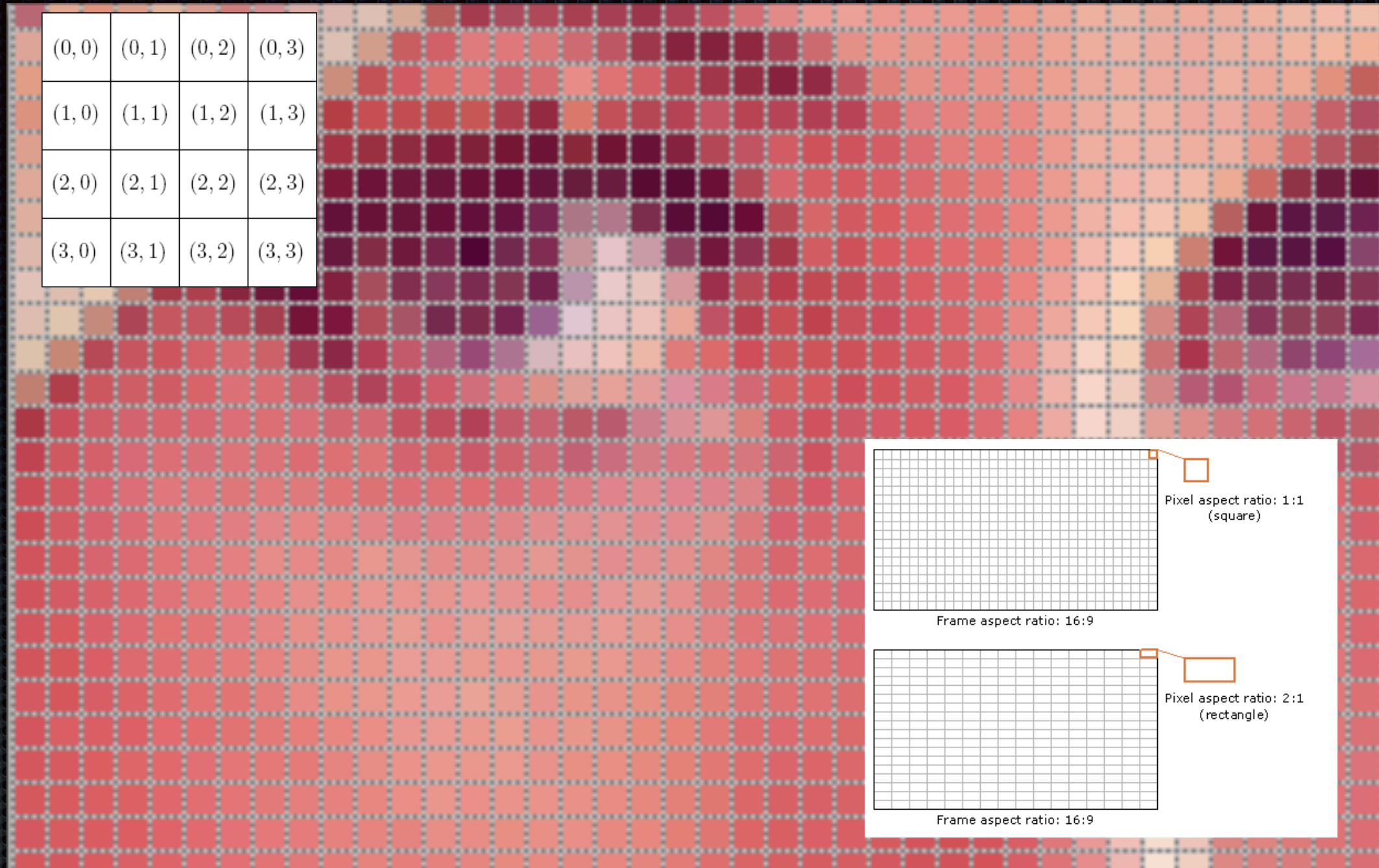
Visual Effects:

If it *looks* correct, then it is *correct*.

Digital

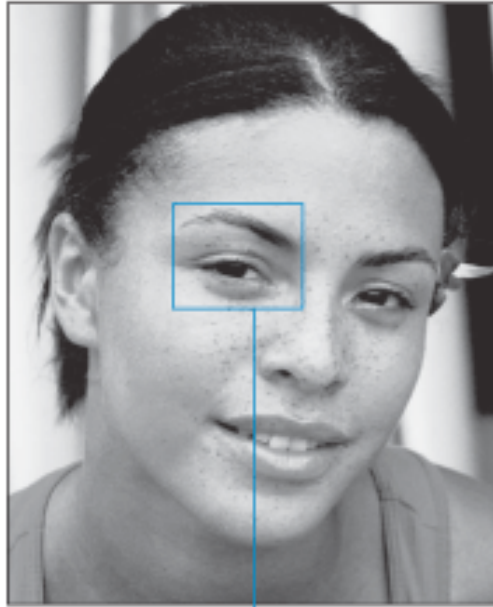
Pixels, bits, formats, & standards.

(0, 0)	(0, 1)	(0, 2)	(0, 3)
(1, 0)	(1, 1)	(1, 2)	(1, 3)
(2, 0)	(2, 1)	(2, 2)	(2, 3)
(3, 0)	(3, 1)	(3, 2)	(3, 3)



Pixels & Bits

Building blocks of images.



Bit-depth	Values		Range
1	2^1	0 1	2 0, 1
2	2^2	00 01 10 11	4 -1 to +2
3	2^3	000 001 010 011 100 101 110 111	8 -3 to +4
4	2^4	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111	16 -7 to +8
5	2^5	00000 00001 00010 00011 00100 00101 00110 00111 01000 01001 01010 01011 etc	32 -15 to +16
6	2^6	000000 000001 000010 000011 000100 000101 000110 000111 001000 001001 etc	64 -31 to +32
8	2^8	00000000 00000001 00000010 00000011 00000100 00000101 00000110 00000111 etc	256 -127 to +128
16	2^{16}	0000000000000000 0000000000000001 0000000000000010 0000000000000011 etc	65 536 -32 767 to +32 768
24	2^{24}	000000000000000000000000 000000000000000000000001 etc	16 777 216 -8 388 607 to +8 388 608
32	2^{32}	00000000000000000000000000000000 00000000000000000000000000000001 etc	4 294 967 296 -2 147 483 647 to +2 147 483 648
64	2^{64}	00 etc	1.8×10^{19} $\pm 9 \times 10^{18}$
128	2^{128}	You get the idea	3.4×10^{38} $\pm 1.7 \times 10^{19}$



1 bit
2 possible values



2 bits
4 possible values



4 bits
16 possible values



8 bits
256 possible values

© Apple Computer, Inc.

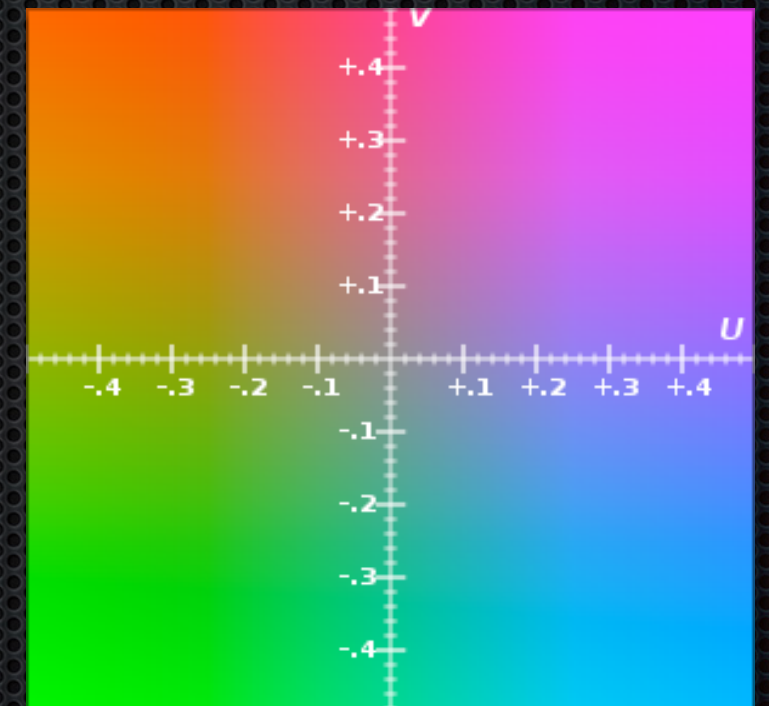
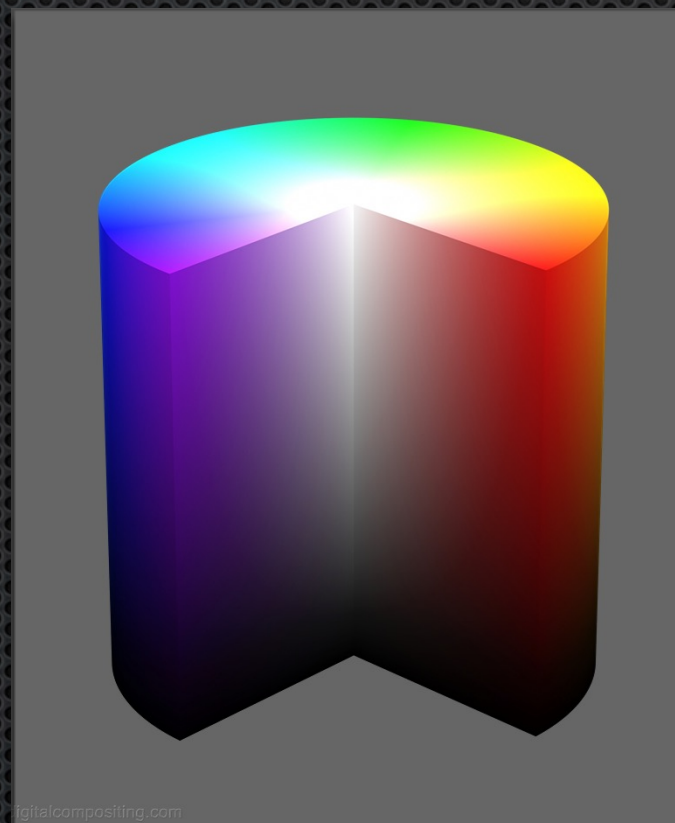
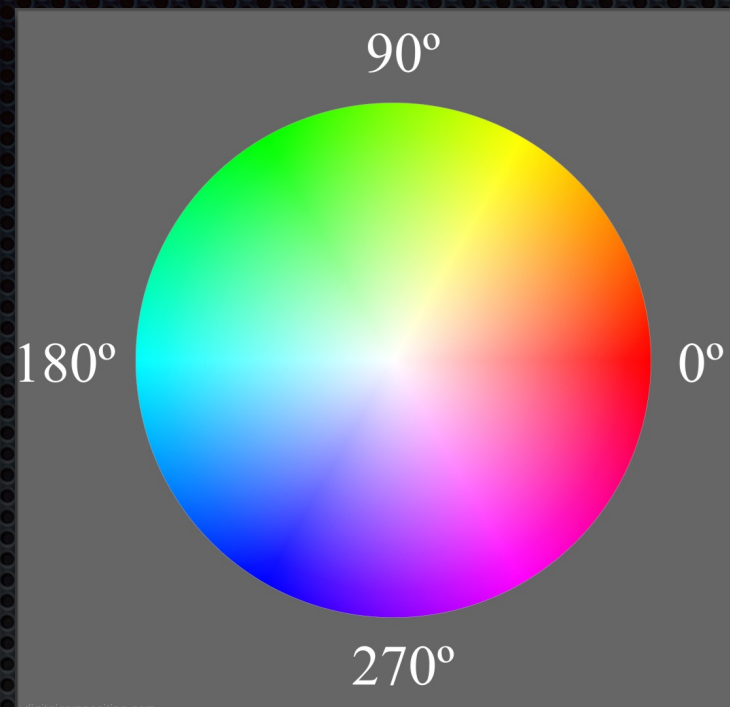
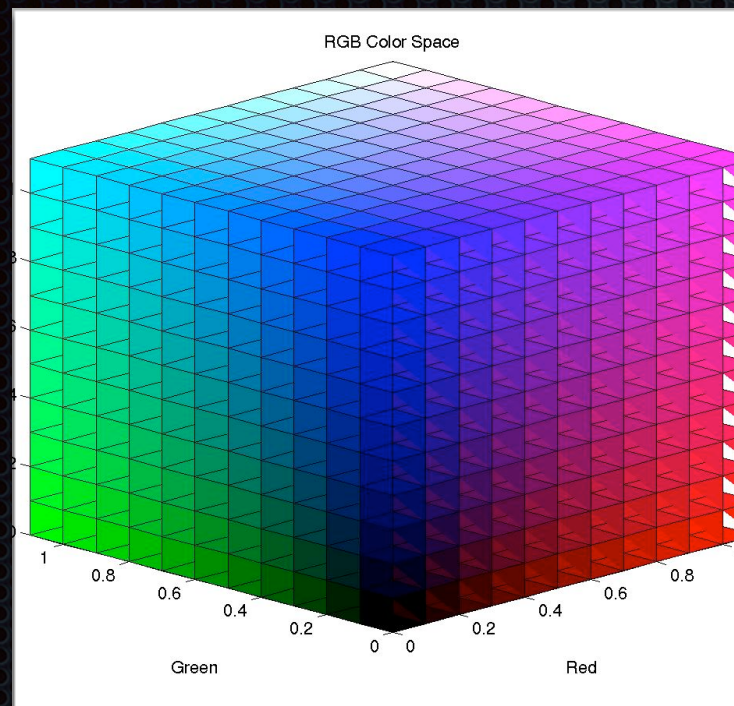
Pixels & Bits

Bit-depth.



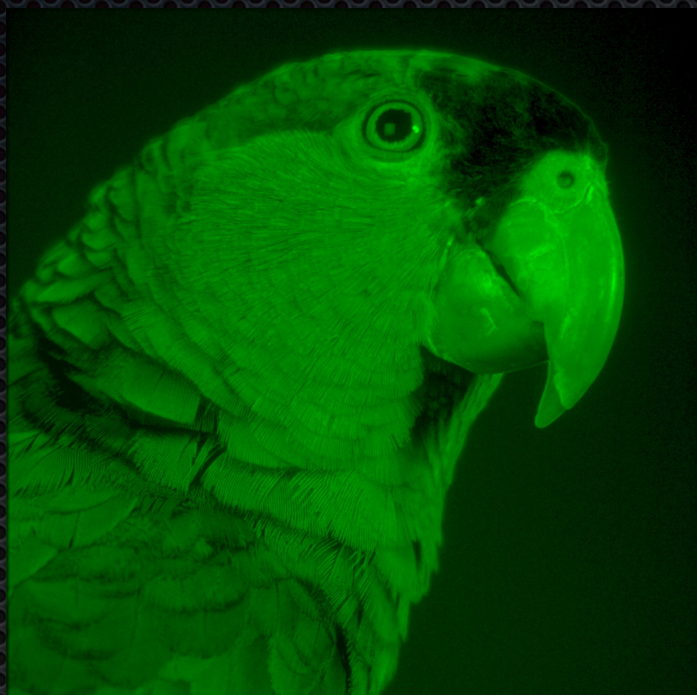
Pixels & Bits

Bit-depth with color.



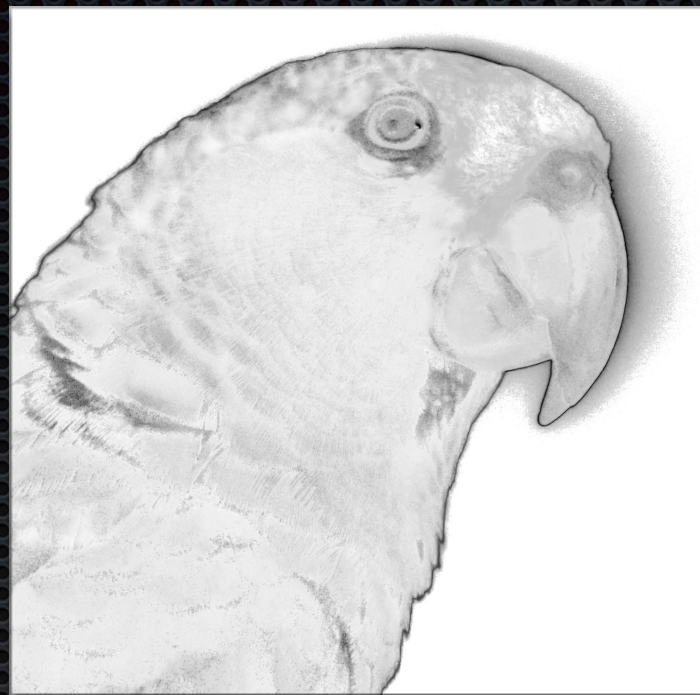
Color

RGB, HSV, YUV, & more...



RGB
Color
Channels





HSV
Color
Channels

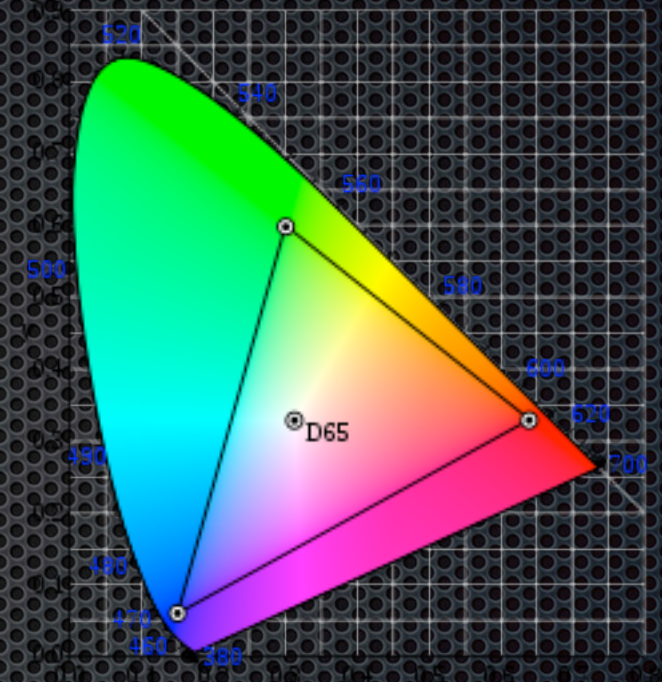
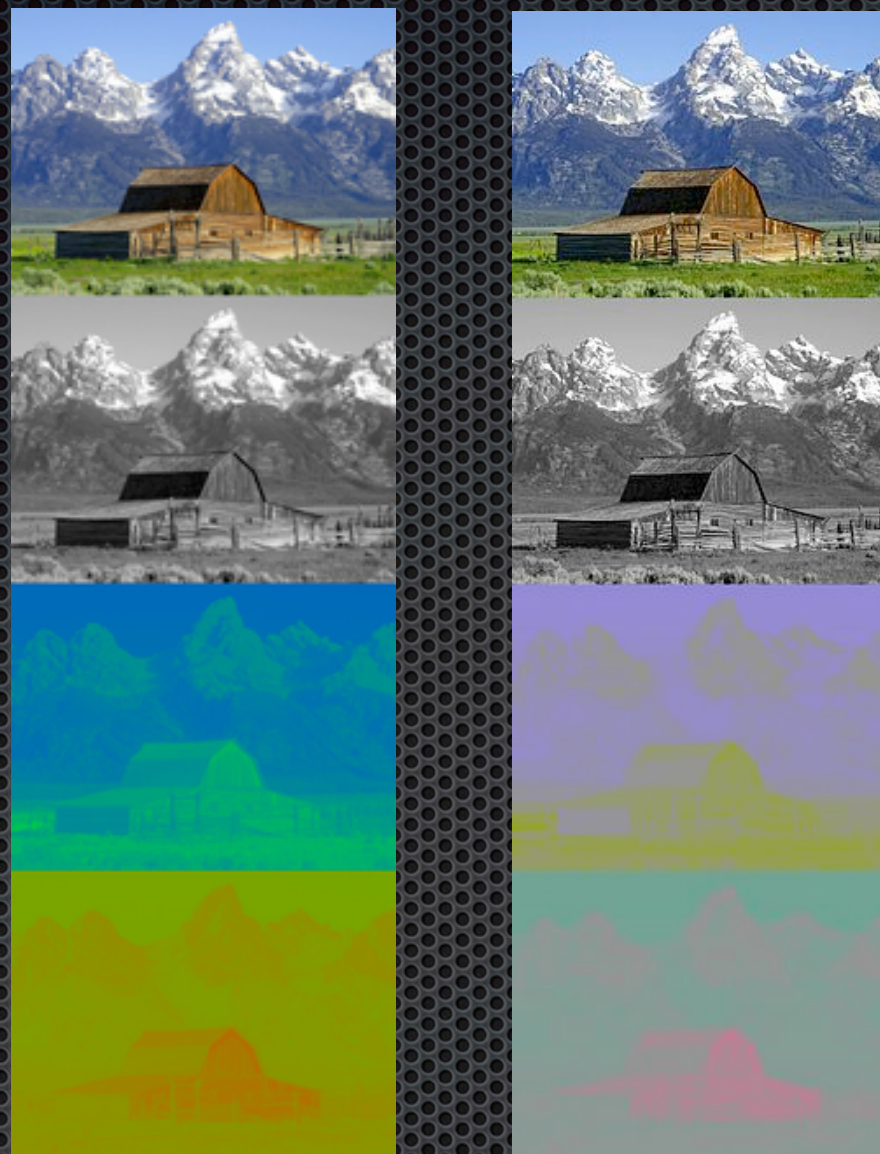
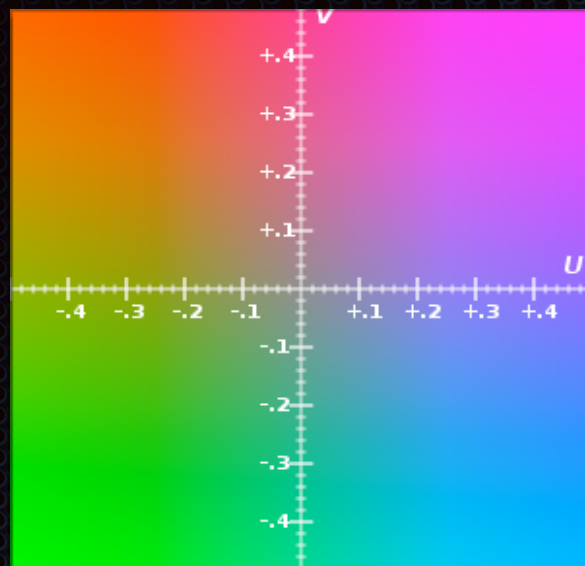




YUV Color Channels



YUV (analog), YCbCr (digital, luminance: sum of linear components), Y'CbCr (digital, luma: sum of log components)

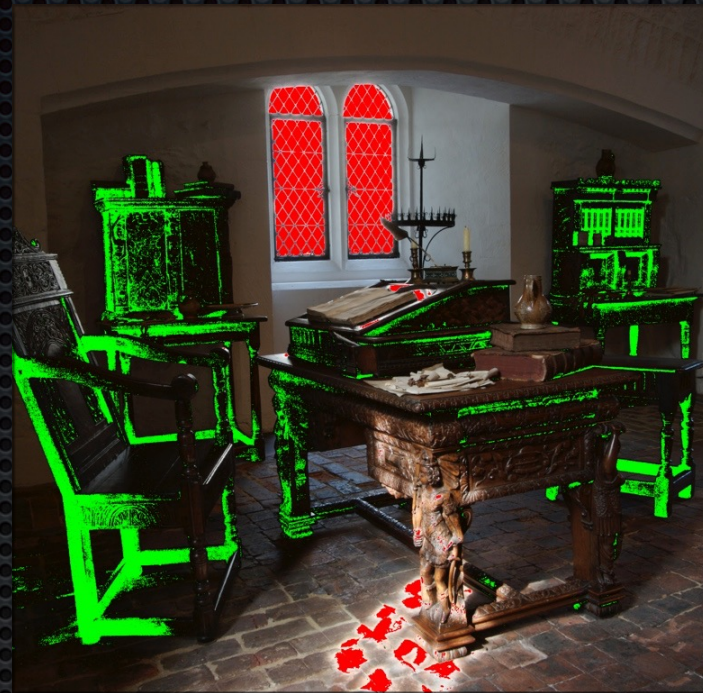


YUV,
YCbCr,
Y'CbCr,
Chroma subsampling --- 4:4:4, 4:2:2, 4:1:1
ITU-R Rec. 709 (1990 HDTV standard)

YUV (analog), YCbCr (digital, luminance: sum of linear components), Y'CbCr (digital, luma: sum of log components)

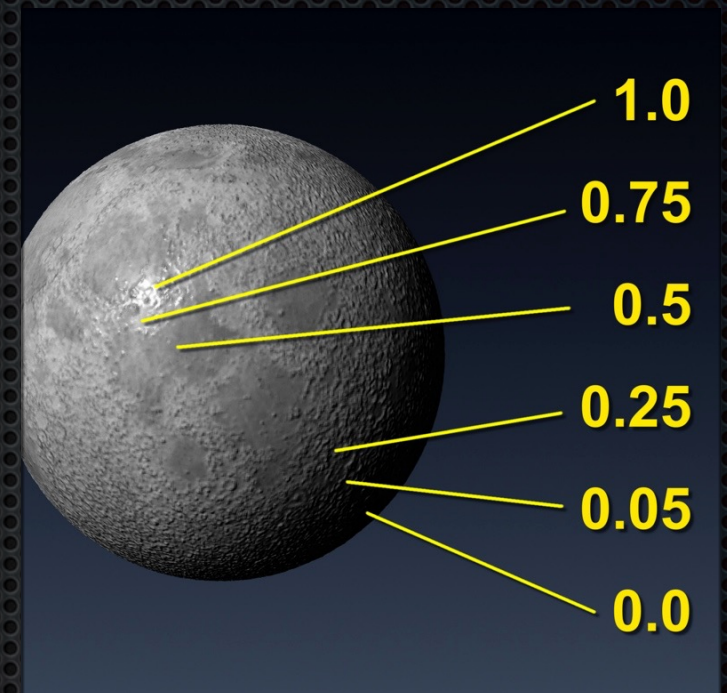
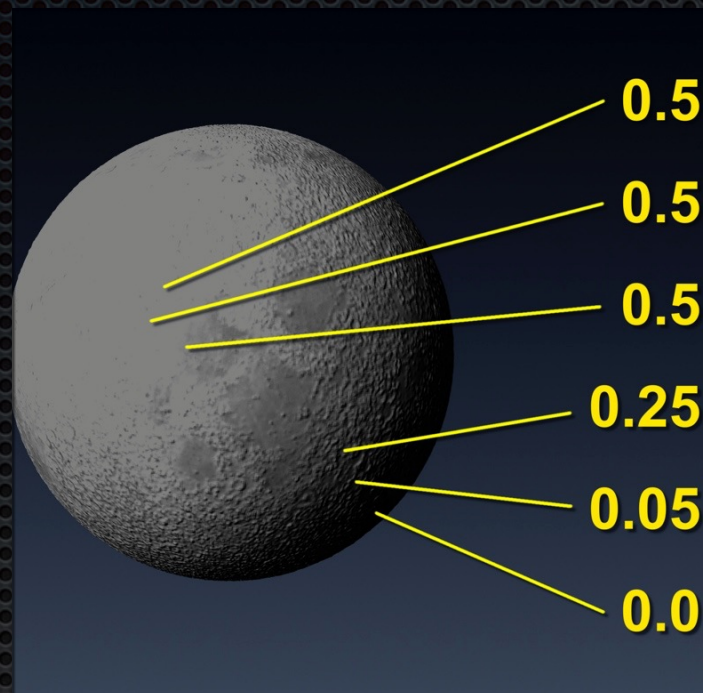
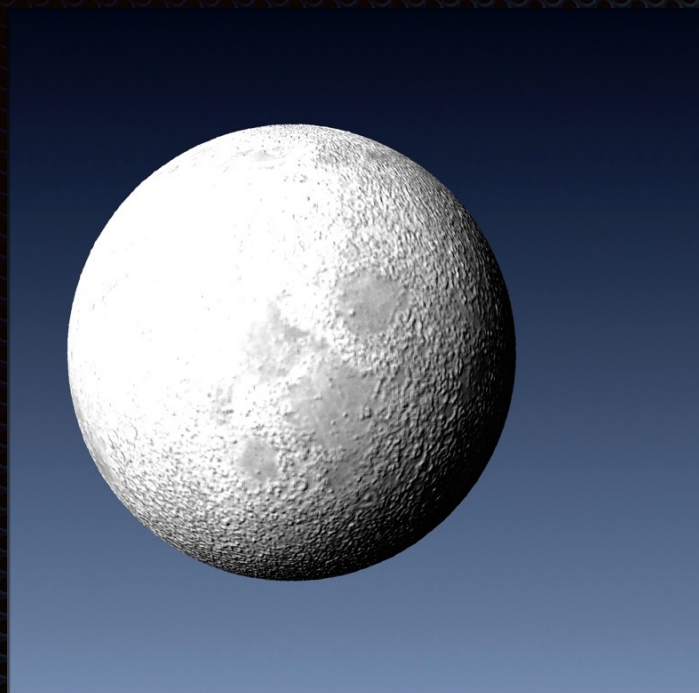


Exposure, Brightness, and Numerical Representation

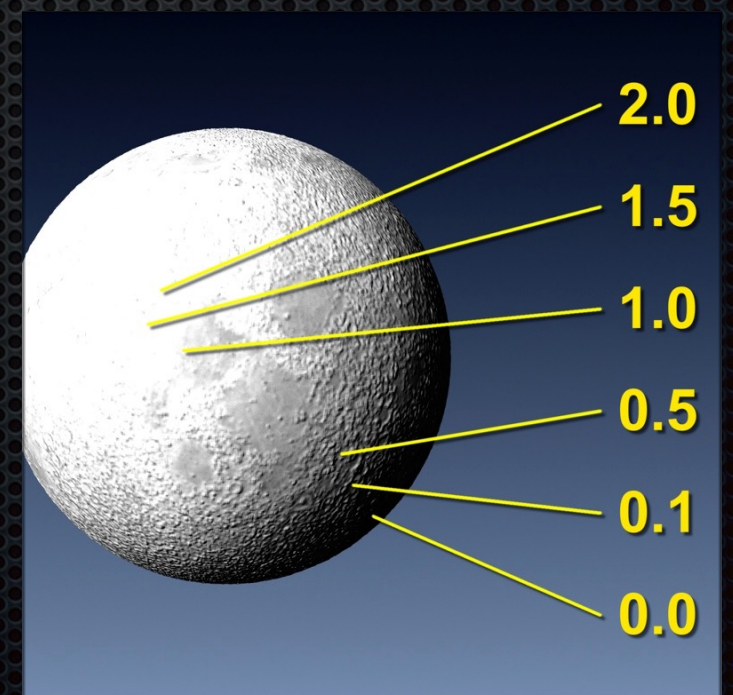


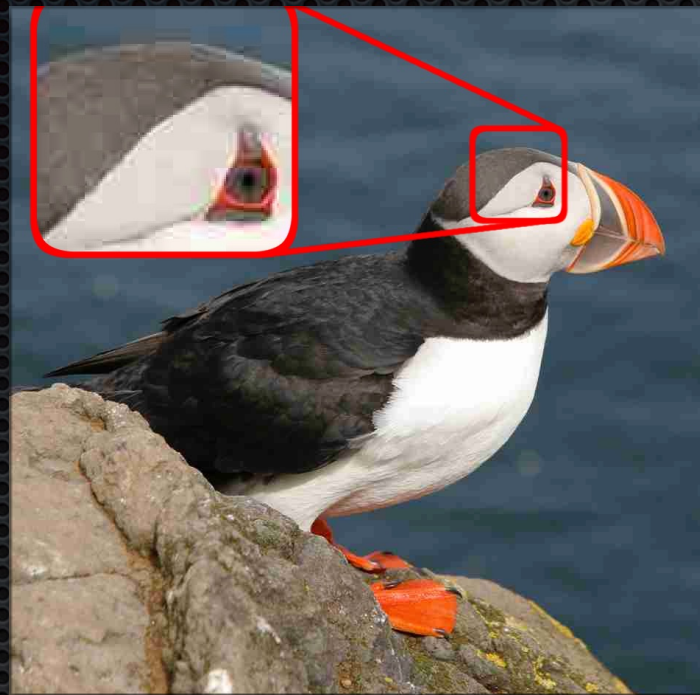
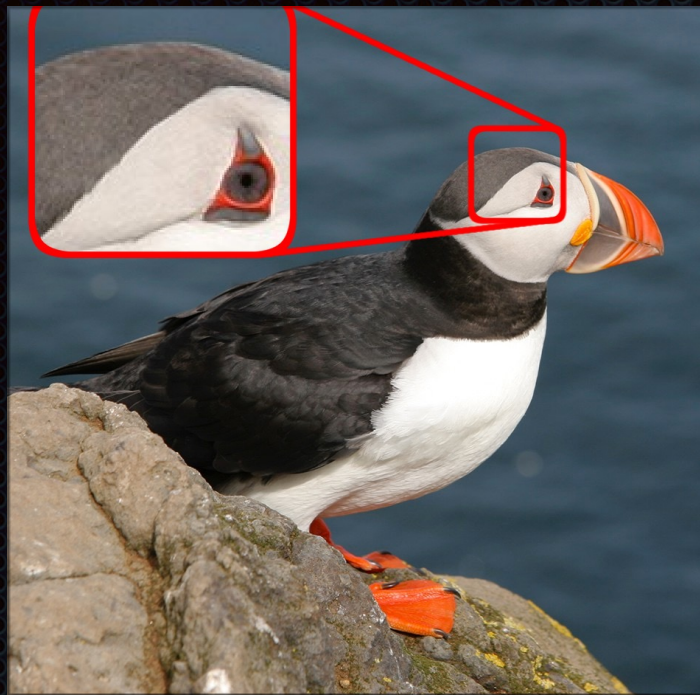
Exposure, Brightness, and
Numerical Representation





Exposure, Brightness, and
Numerical Representation





Quantization, Encoding, &
Compression

