Gamma Correction

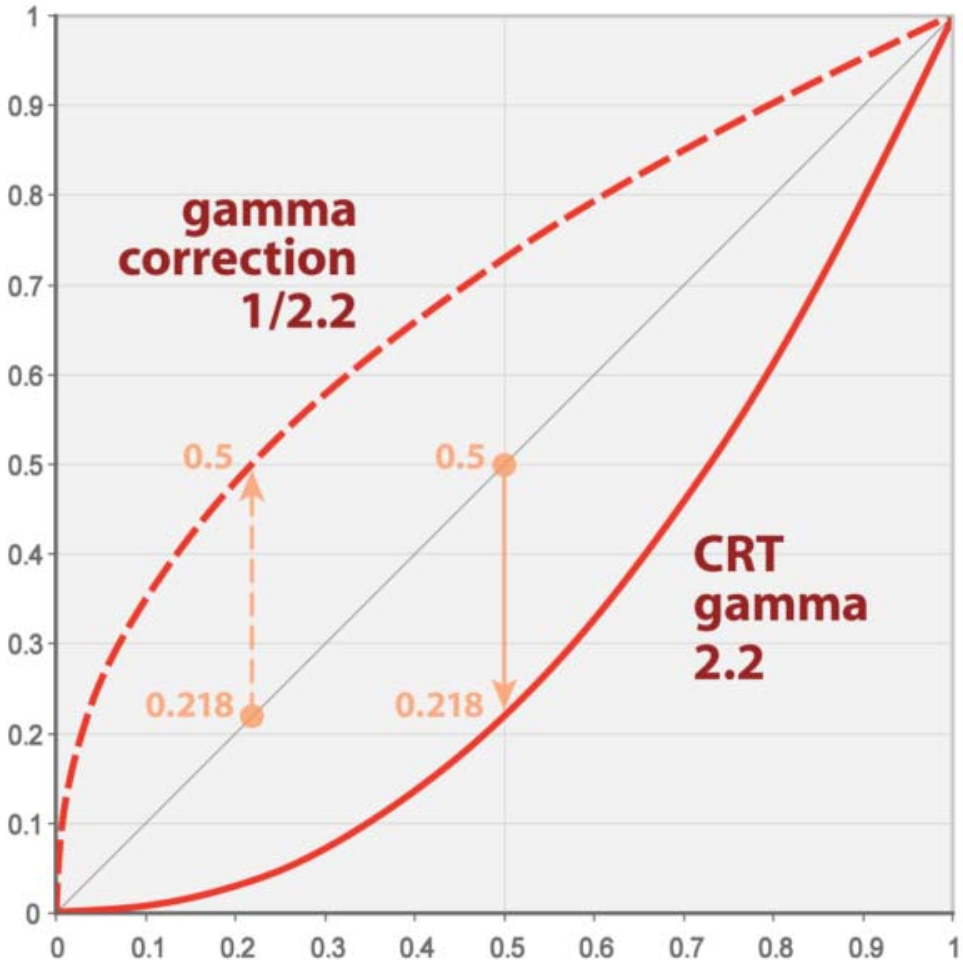
- **Video camera transfer functions**
  - The original NTSC video standards specified a simple power-law camera transfer function with an exponent of 1/2.2 (about 0.45). This is not possible to implement exactly in analog hardware because the function has infinite slope at x=0, so all cameras deviated to some degree from this ideal.
  - More recently, a new camera transfer function that is physically realizable has been accepted as a standard [SMPTE-170M]. It is

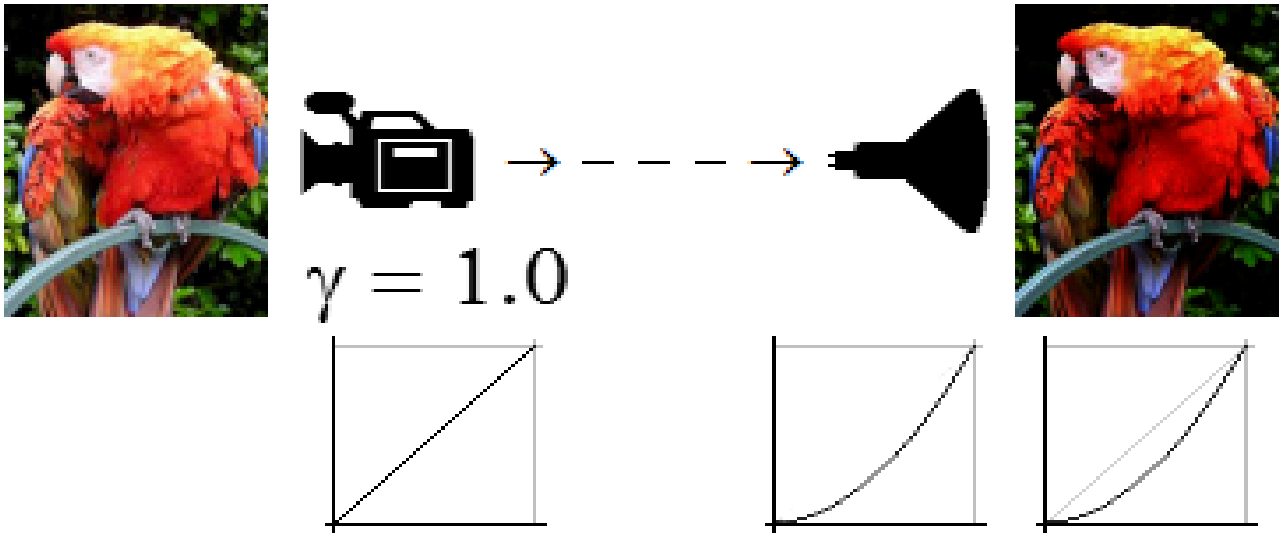
    If (Vin < 0.018) Vout = 4.5 * Vin

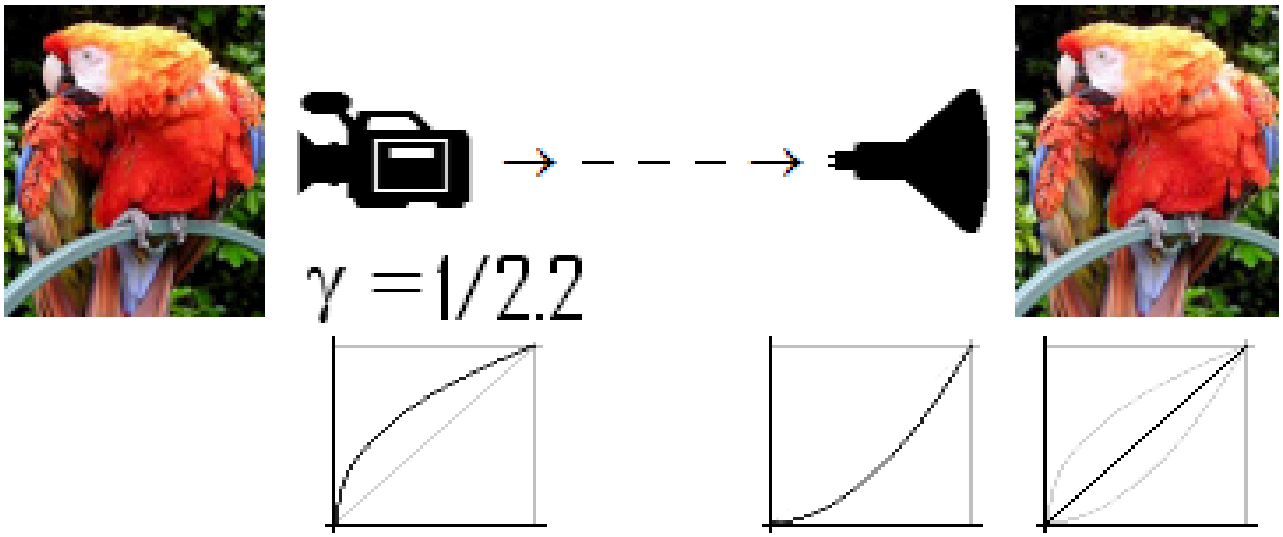
    if (Vin >= 0.018) Vout = 1.099 * (Vin^0.45) - 0.099

    where Vin and Vout are measured on a scale of 0 to 1.
- Although the exponent remains 0.45, the multiplication and subtraction change the shape of the transfer function, so it is no longer a pure power function. It can be well approximated, however, by a power function with exponent 0.52.
- The PAL and SECAM video standards specify a power-law camera transfer function with an exponent of 1/2.8 (about 0.36). However, this is too low in practice, so real cameras are likely to have exponents close to NTSC practice.

Gamma Correction

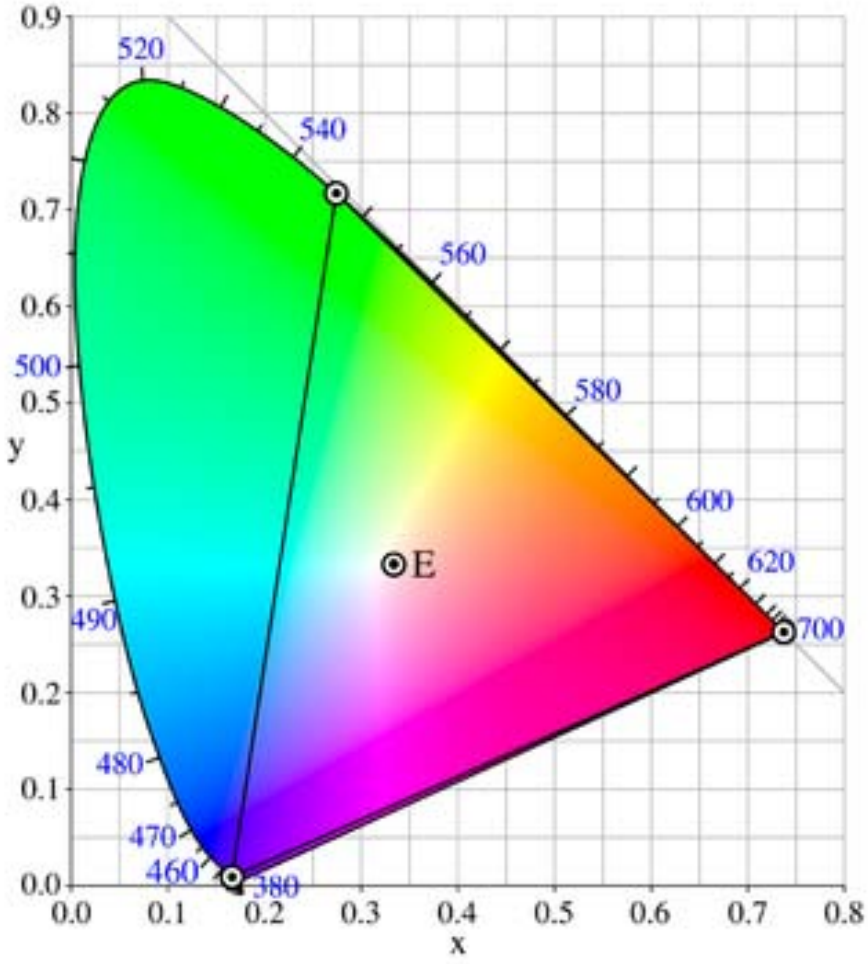


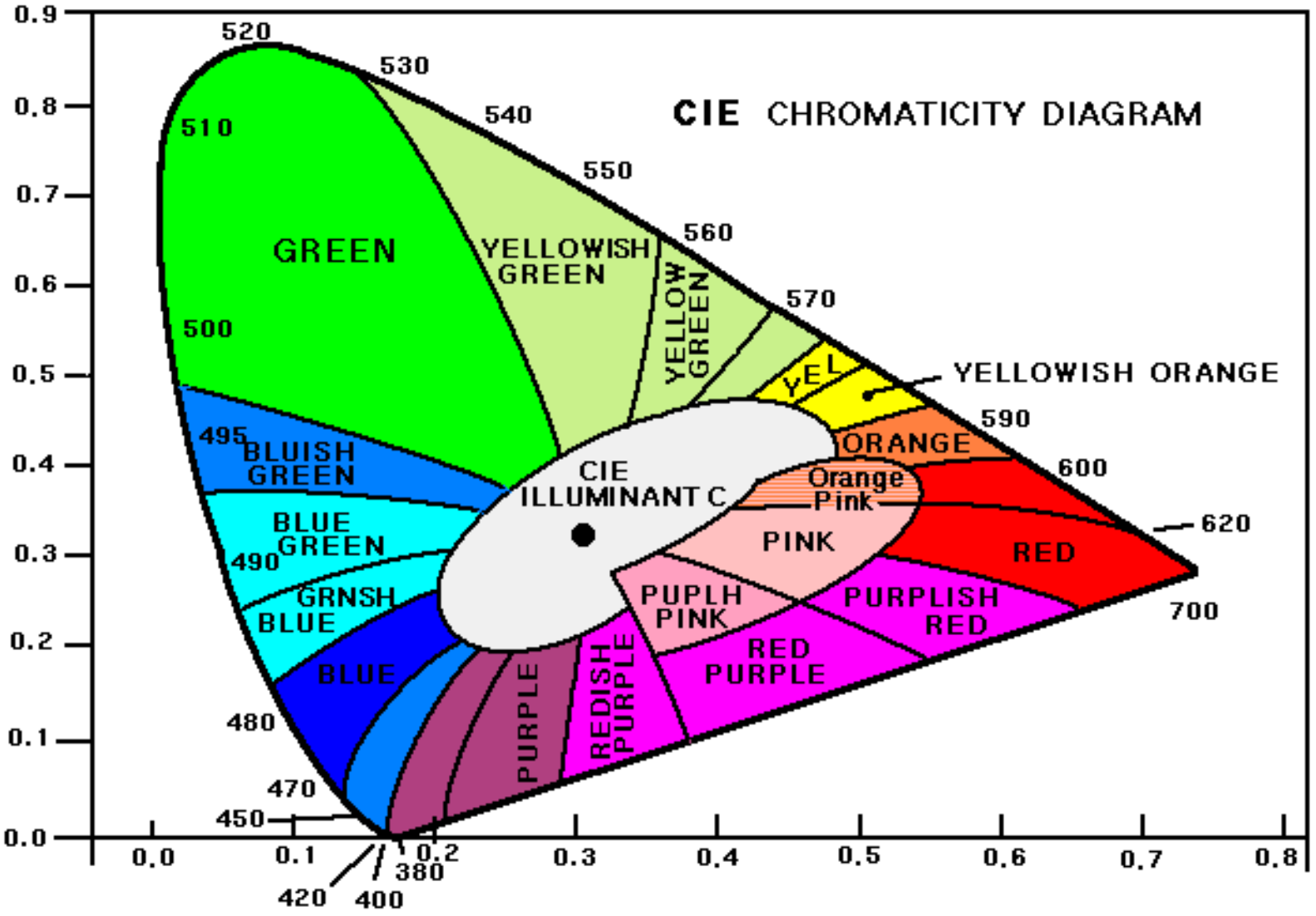

$\gamma = 1.0$


$\gamma = 1/2.2$

CIE 1931 color space

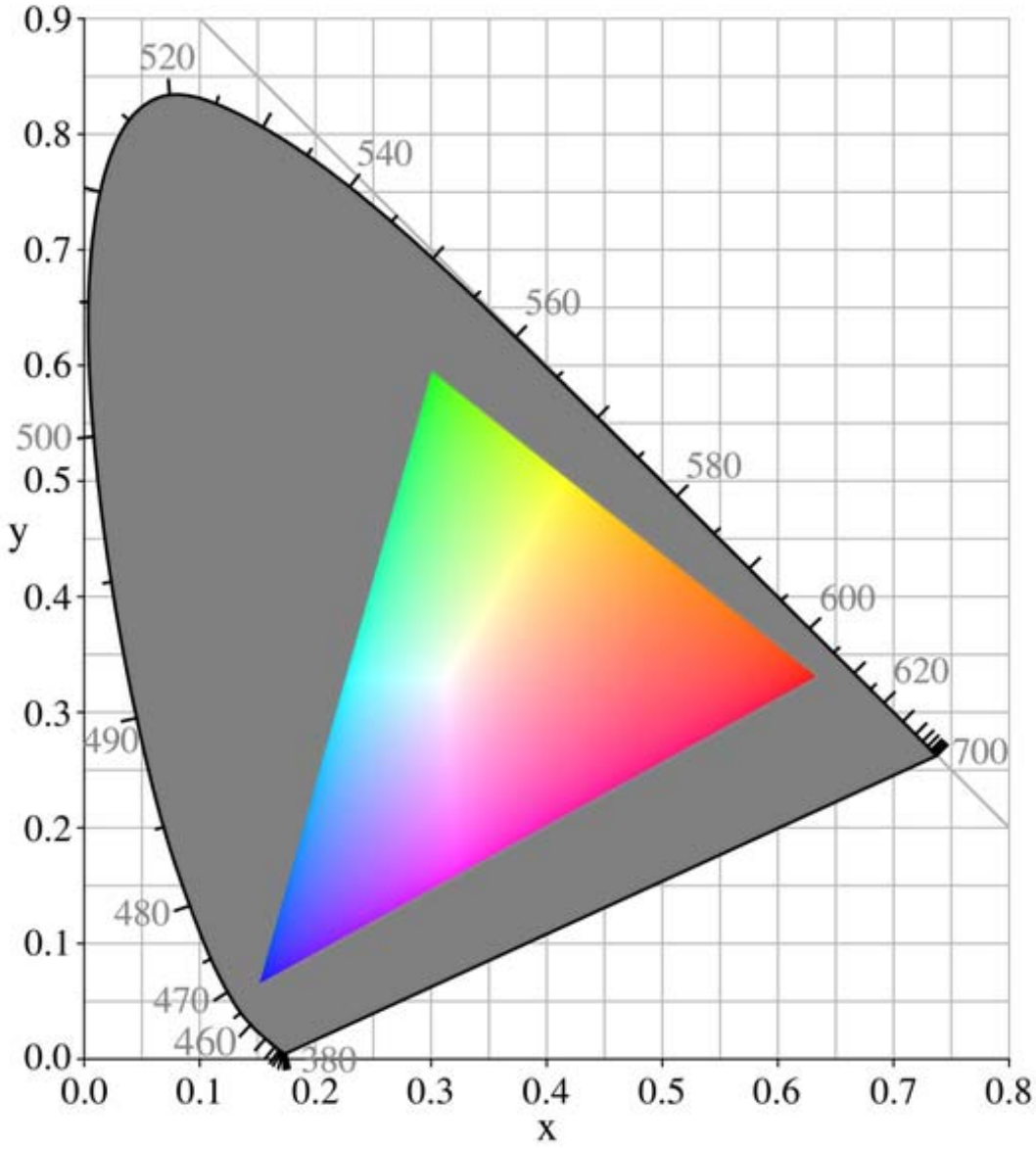
- created by the Commission Internationale de L'Eclairage (CIE) in 1931
- The diagram represents all of the chromaticities visible to the average person.
- Three monochromatic primaries at standardized wavelengths of 700 nm (red), 546.1 nm (green) and 435.8 nm (blue)




CIE CHROMATICITY DIAGRAM
520
530
540
550
560
570
590
600
620
700
510
500
495
490
480
470
450
420
400
380
GREEN
YELLOWISH GREEN
YELLOW GREEN
YEL
YELLOWISH ORANGE
ORANGE
Orange Pink
PINK
RED
BLUISH GREEN
BLUE GREEN
GRNSH BLUE
BLUE
PUPLH PINK
PURPLISH RED
RED PURPLE
REDISH PURPLE
PURPLE
CIE ILLUMINANT C
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

A typical CRT gamut

- The grayed-out horseshoe shape is the entire range of possible chromaticities. The colored triangle is the gamut available to a typical computer monitor; it does not cover the entire space.
- The corners of the triangle are the primary colors for this gamut; in the case of a CRT, they depend on the colors of the phosphors of the monitor.
- 奇美廣色域


0.9
0.8
0.7
0.6
500
0.5
y
0.4
0.3
490
0.2
480
0.1
470
460
0.0
380
520
540
560
580
600
620
700
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
x