Computer Science E-7
Exposing Digital Photography

Lecture 6: The Histogram
March 9, 2009

danallan@mit.edu

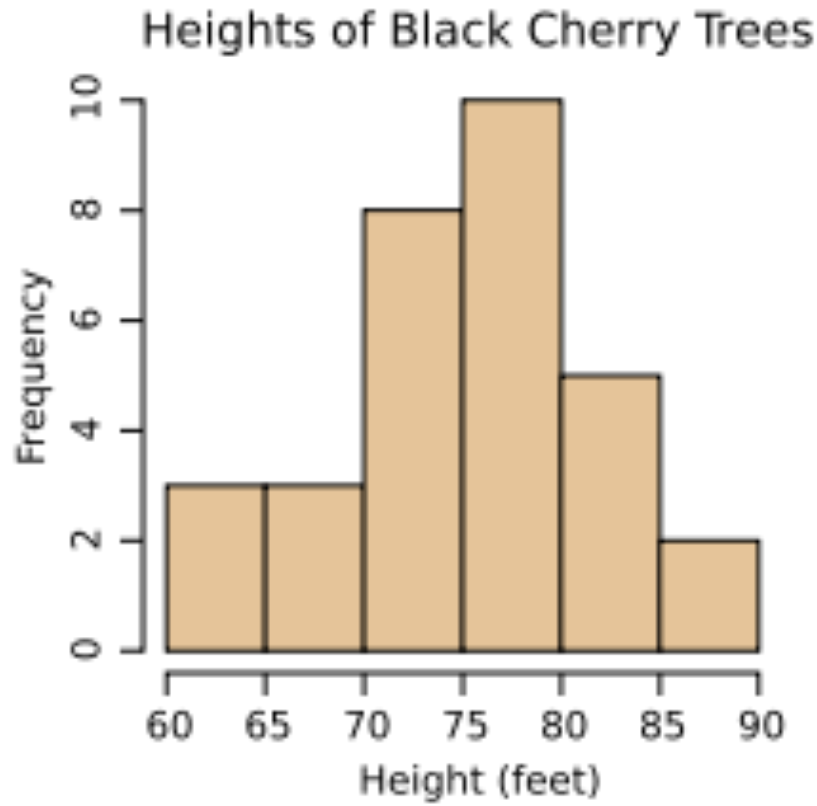
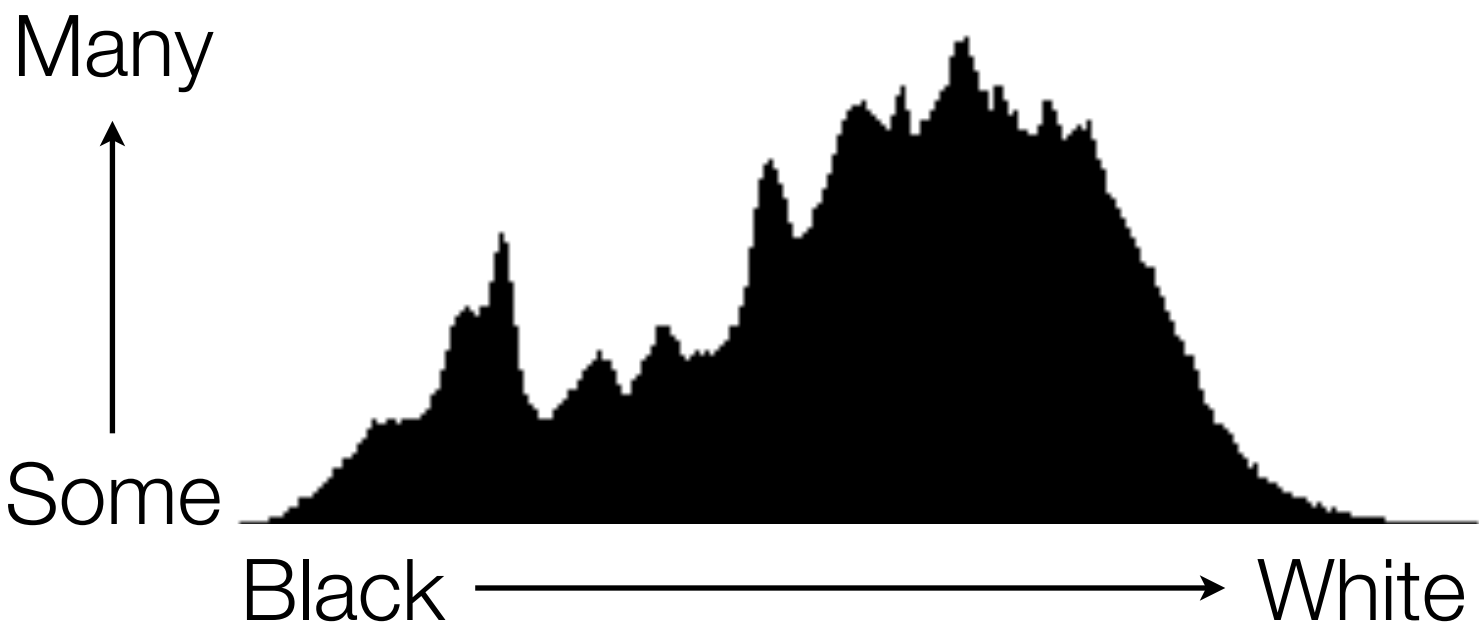


Image from http://en.wikipedia.org/wiki/Histogram

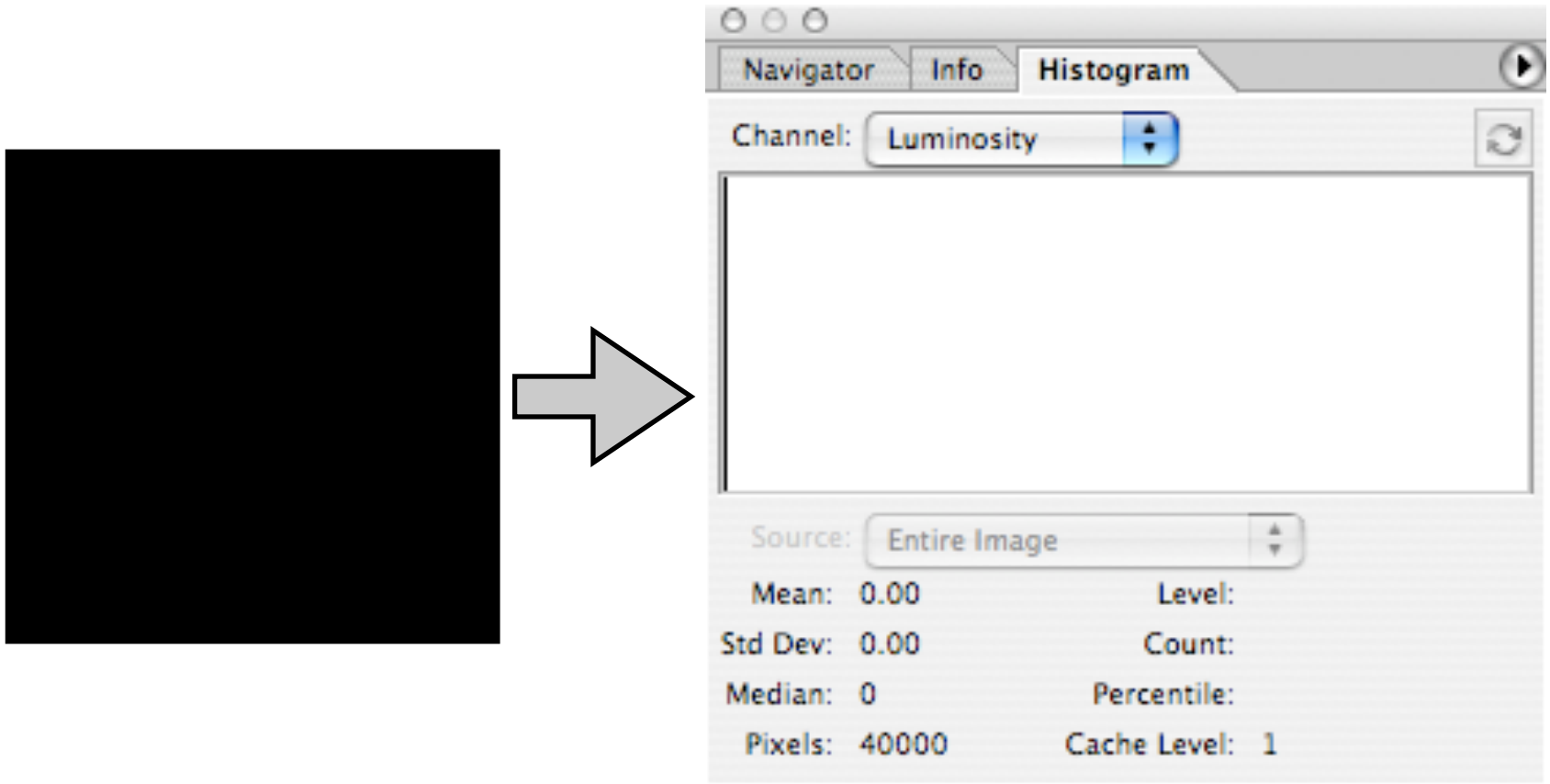
Histograms

General Histogram



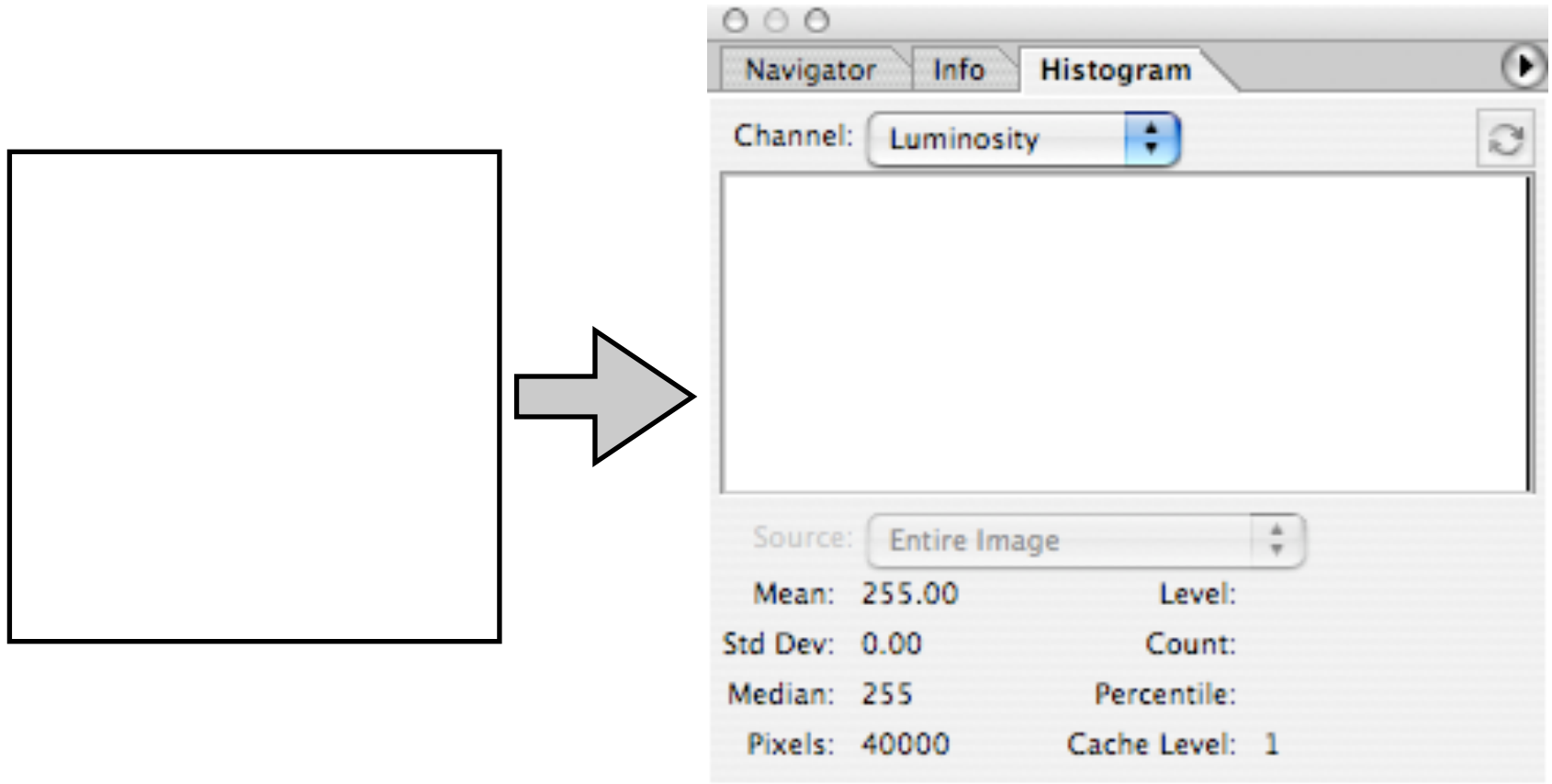
Histograms

Digital Photography



Histograms

Total Underexposure



Histograms

Total Overexposure

309s, ISO 100

Photo by Dan Armendariz, 2009

Histograms

Well-exposed samples

1/1000s, ISO 400, f/5.6

Photo by Dan Armendariz, 2007

Histograms

Well-exposed samples

Photo by Dan Armendariz, 2007

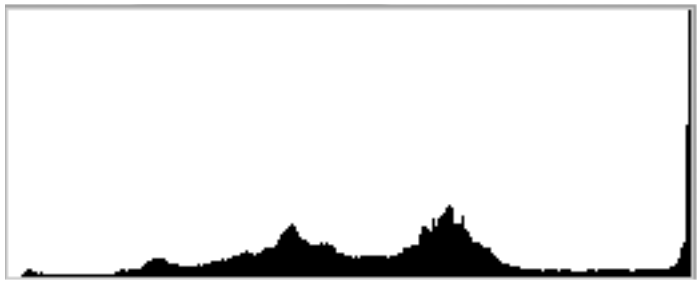
Histograms

Well-exposed samples

Histograms

Under-exposure

Photo by Dan Armendariz, 2005
8.0s, ISO 100, f/8



Histograms

Over-exposure

Photo by Dan Armendariz, 2005
15.0s, ISO 100, f/16

Left: 1/80s, ISO 400, f/2.8, 0ev. Right: 1/80s, ISO 800, f/2.5, +1.3ev

Photos by Dan Armendariz, 2005

Histograms

Exposure Compensation

1/80s, ISO 400, f/10

Photo by Dan Armendariz, 2006

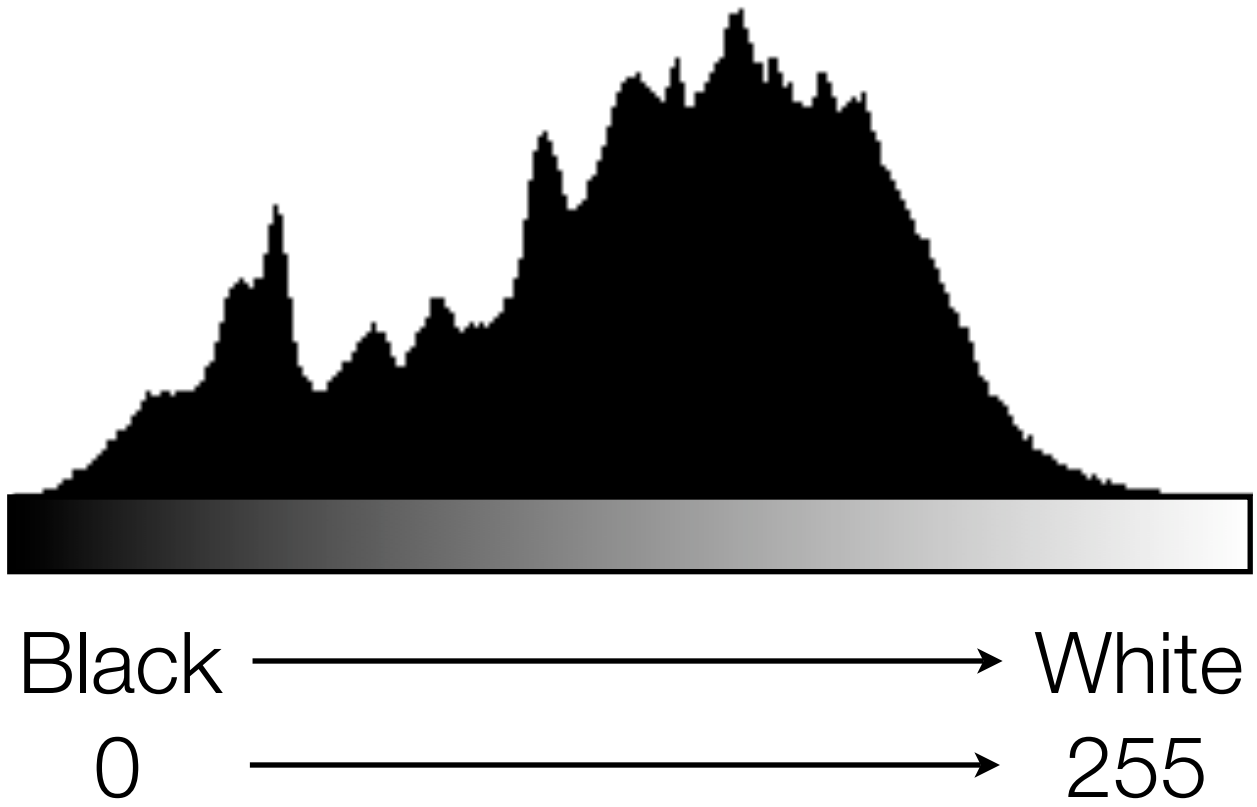
Histograms

Over- & Under-exposure

Bit	0 or 1
Byte	8 bits

Bits and Bytes

Refresher

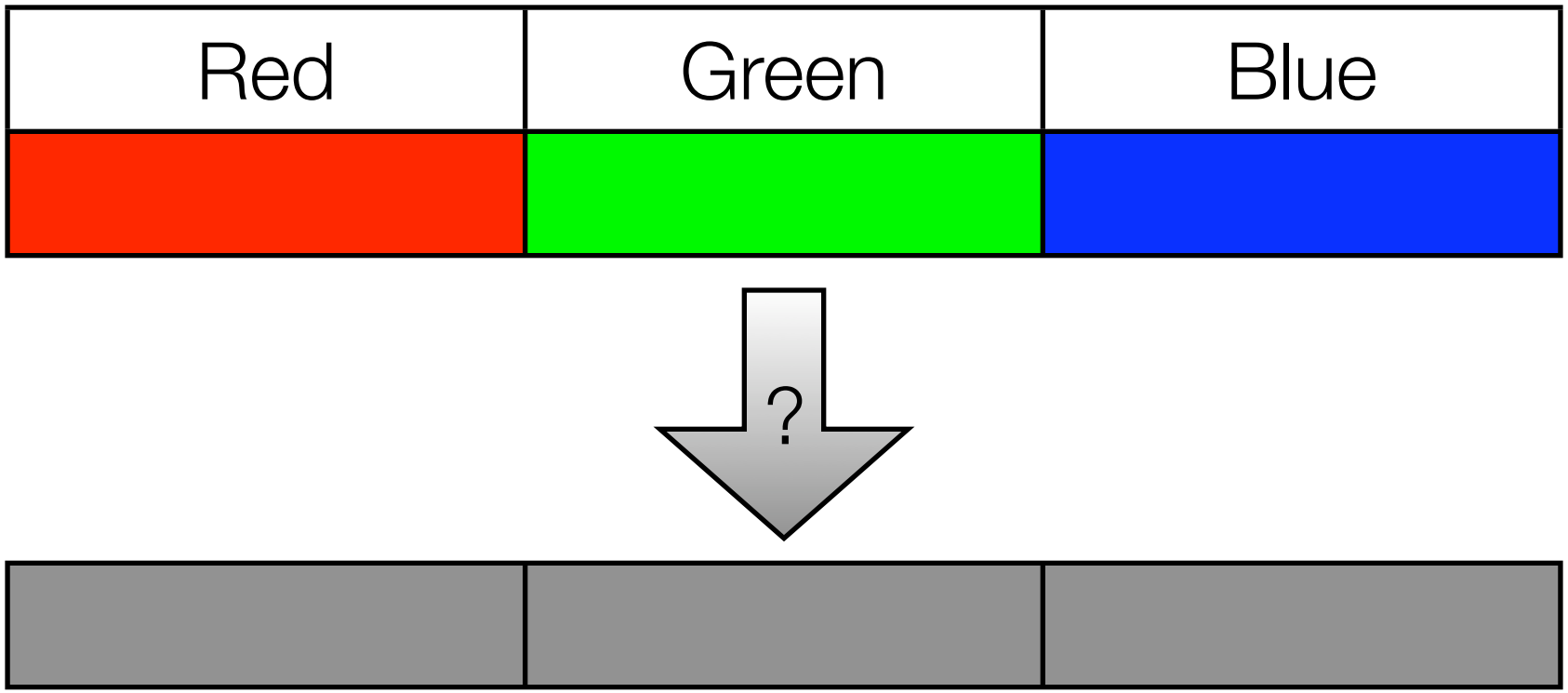


Bits and Bytes

As related to histograms

JPEG

Red	Green	Blue
8-bit	8-bit	8-bit
0 255	0 255	0 255



Histograms

What about color?

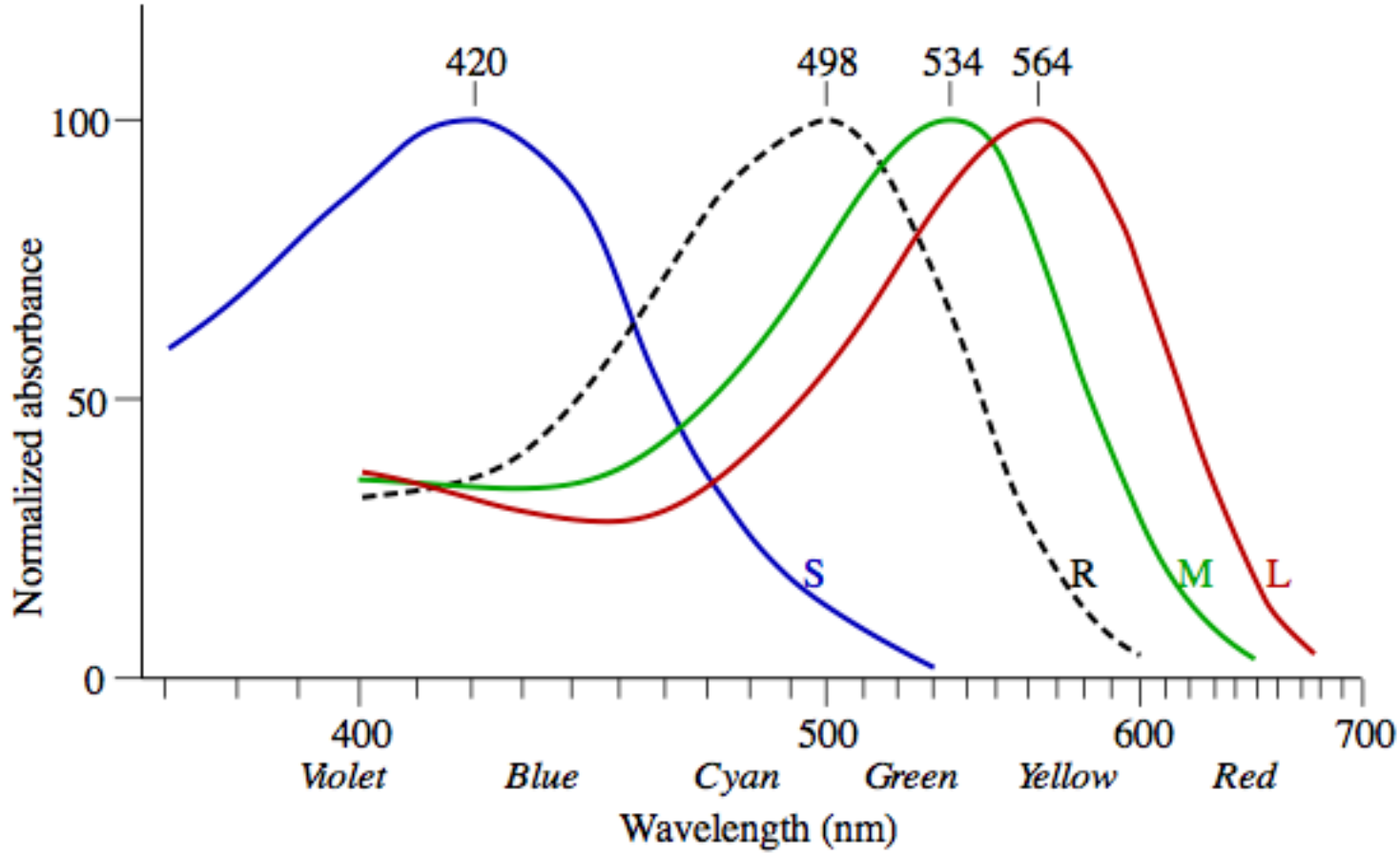
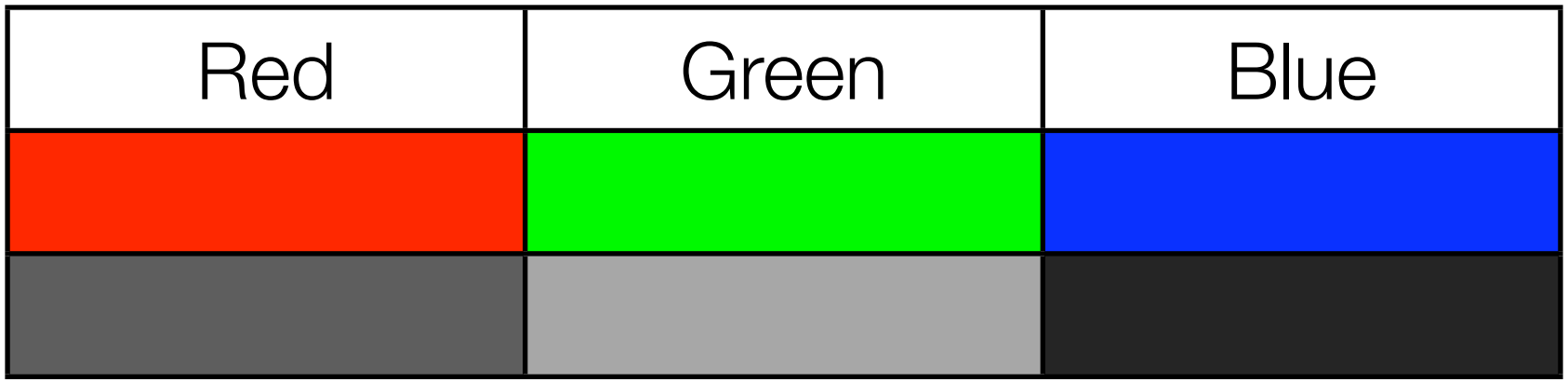


Image from http://en.wikipedia.org/wiki/Trichromacy

The Eye

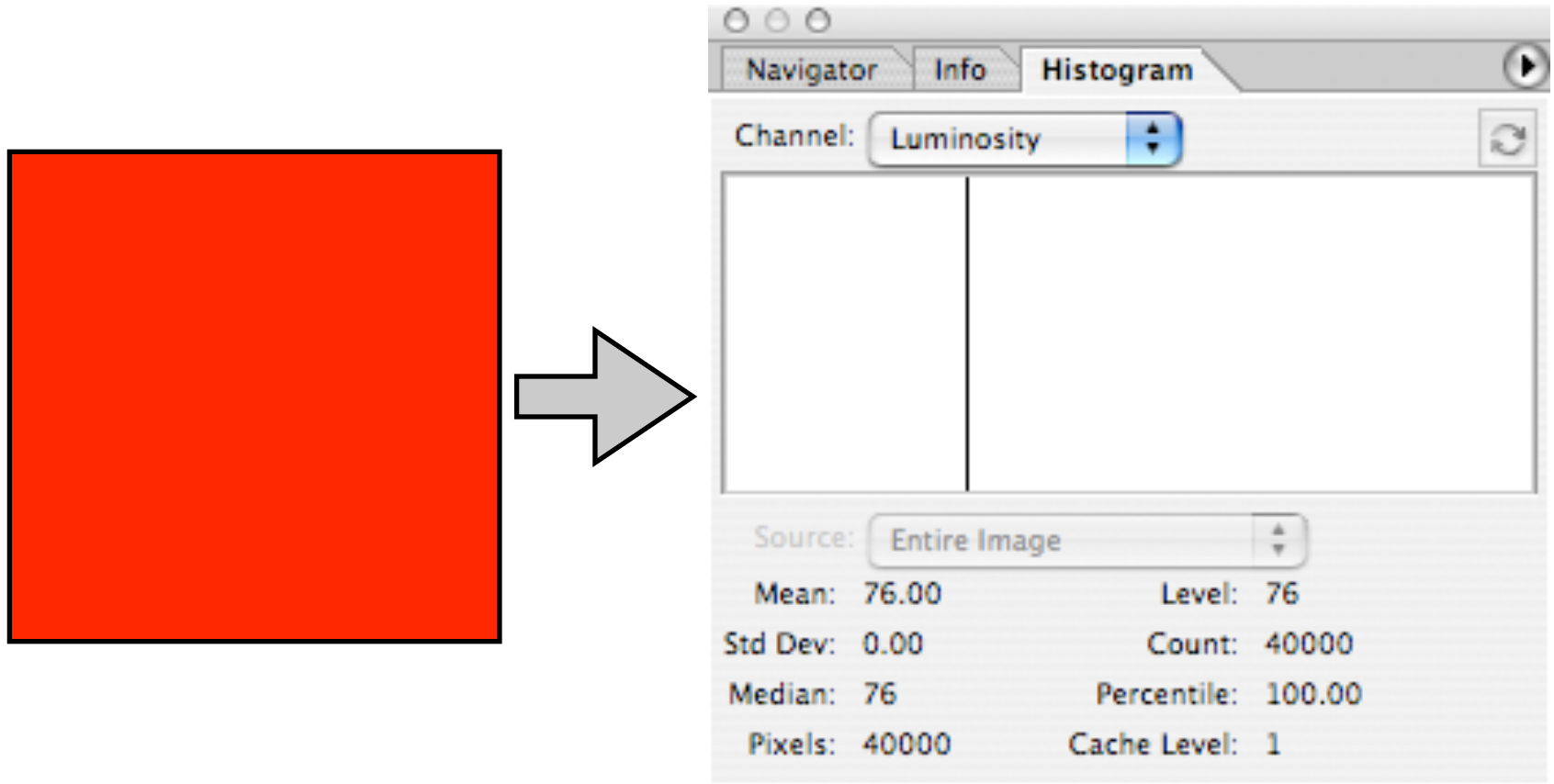
Luminance Detection



The Eye

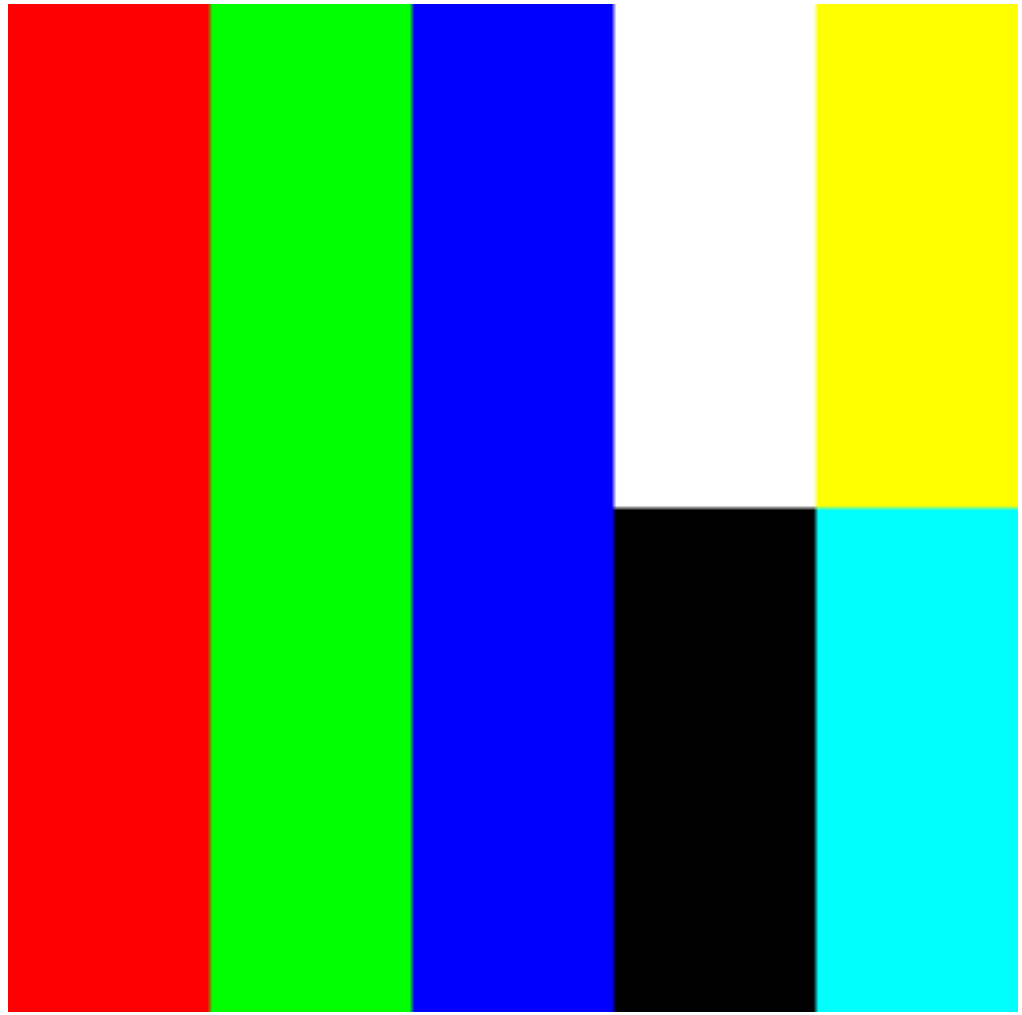
Luminance Detection

$$\text{Luminance} \approx 0.3\,R + 0.59\,G + 0.11\,B$$



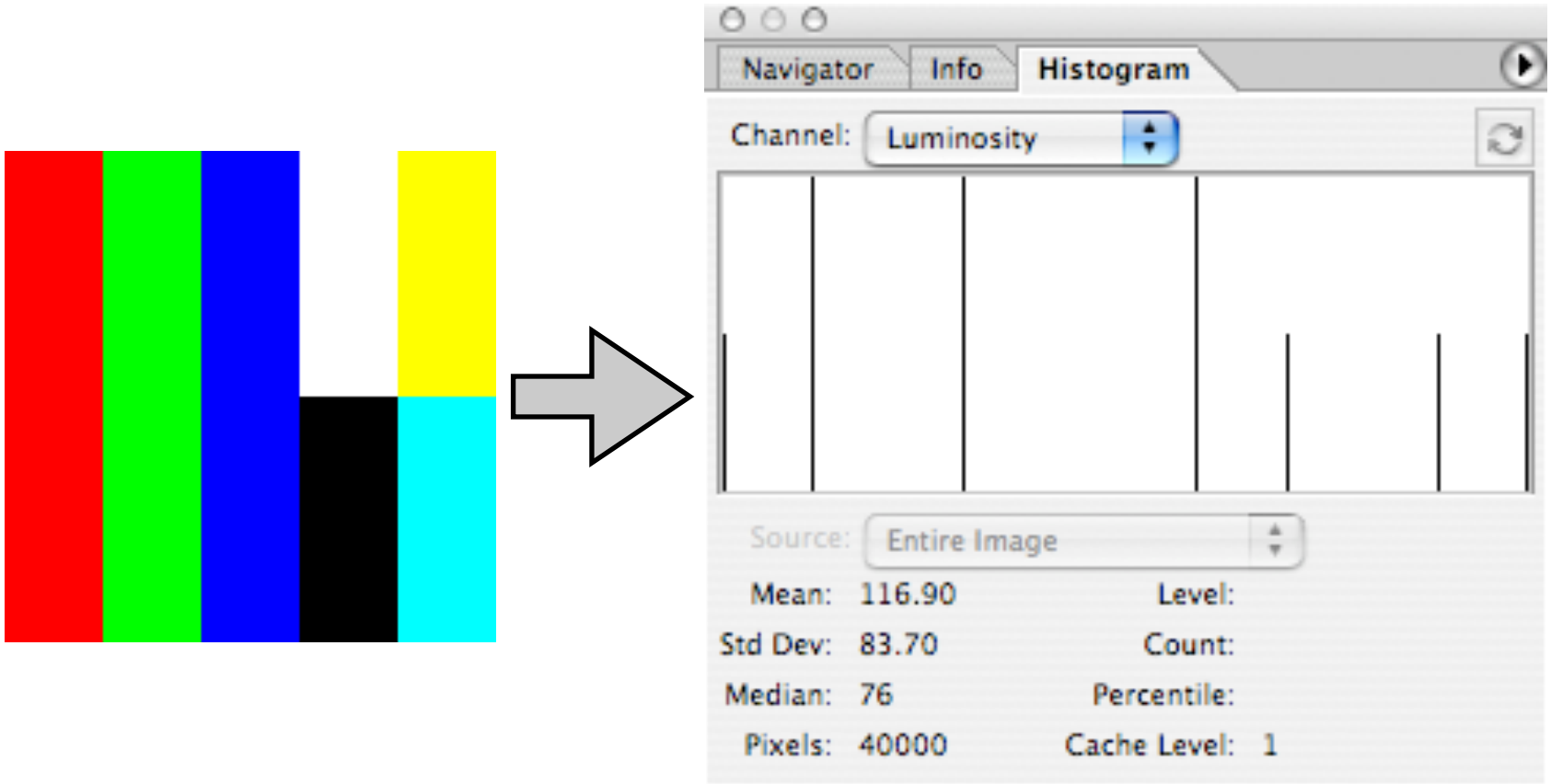
Luminosity Histograms

DIY!



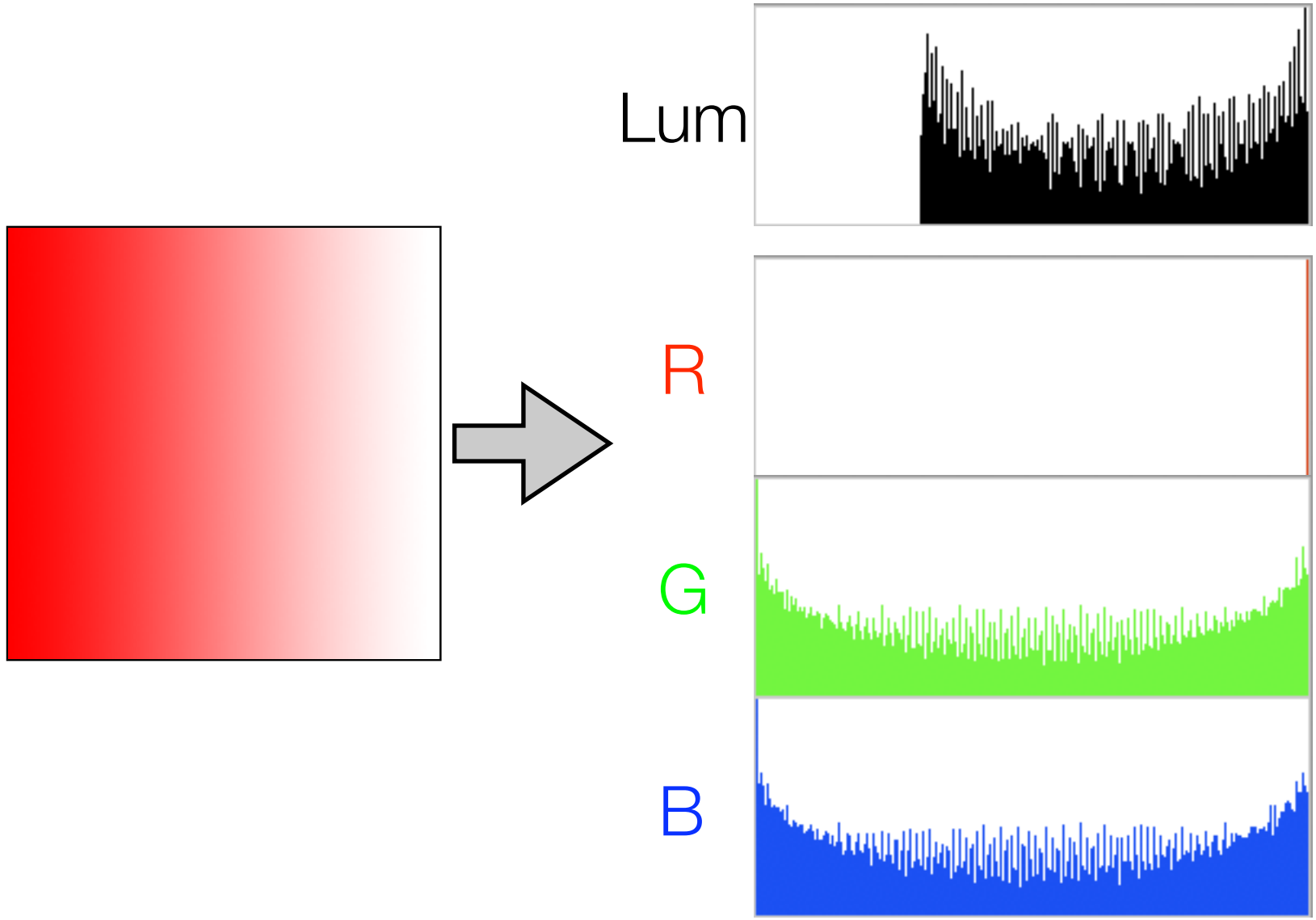
Luminosity Histograms

DIY!



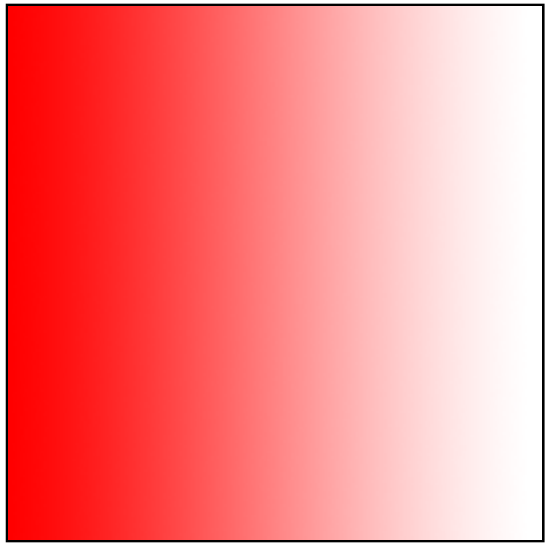
Luminosity Histograms

DIY!

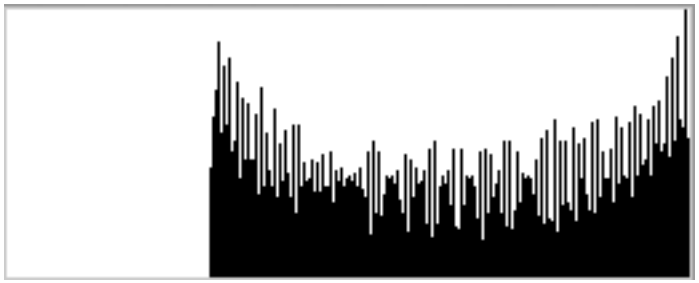


Histograms

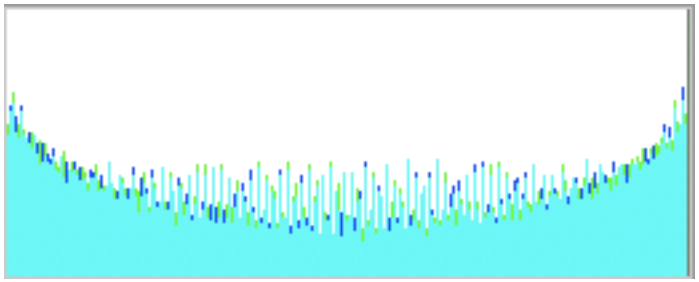
More than just Luminosity...



Lum



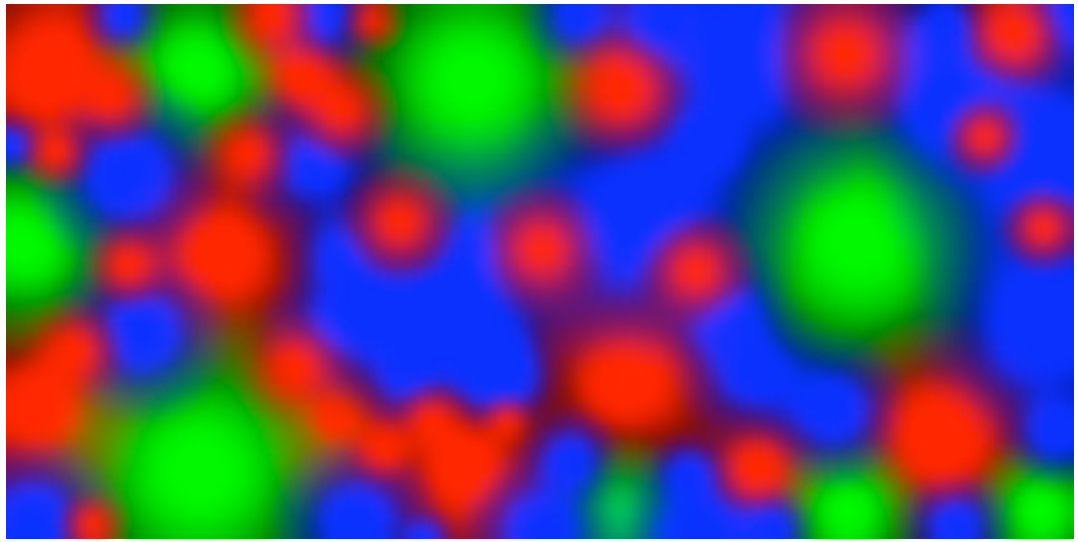
Colors

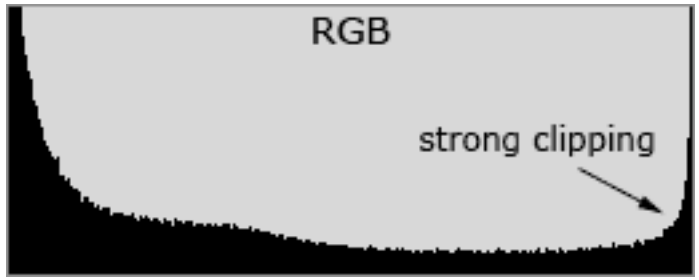


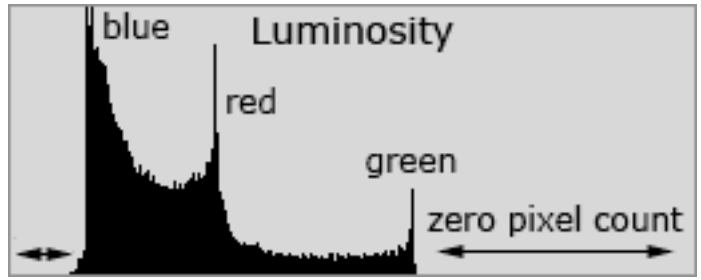
RGB

Histograms

Luminosity, Colors, & RGB



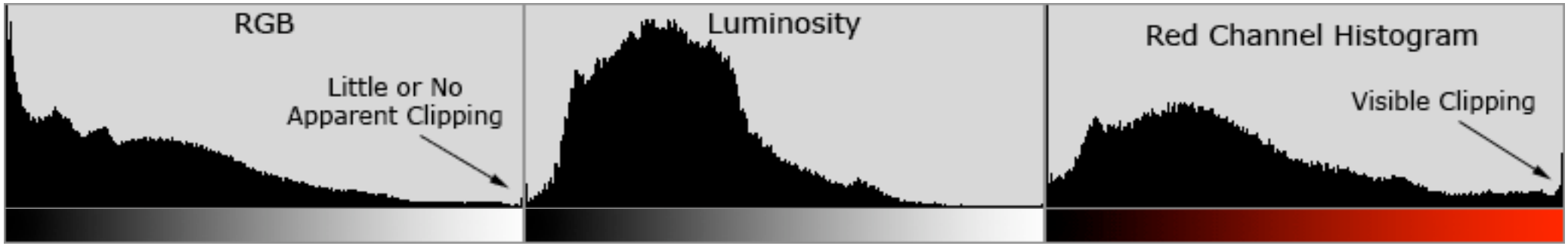




Images from http://www.cambridgeincolour.com/tutorials/histograms2.htm

Histograms

Luminosity, Colors, & RGB



Images from http://www.cambridgeincolour.com/tutorials/histograms2.htm

Histograms

Luminosity, Colors, & RGB

1/80s, ISO 400, f/10

Photo by Dan Armendariz, 2006

Histograms

What is Black and White?

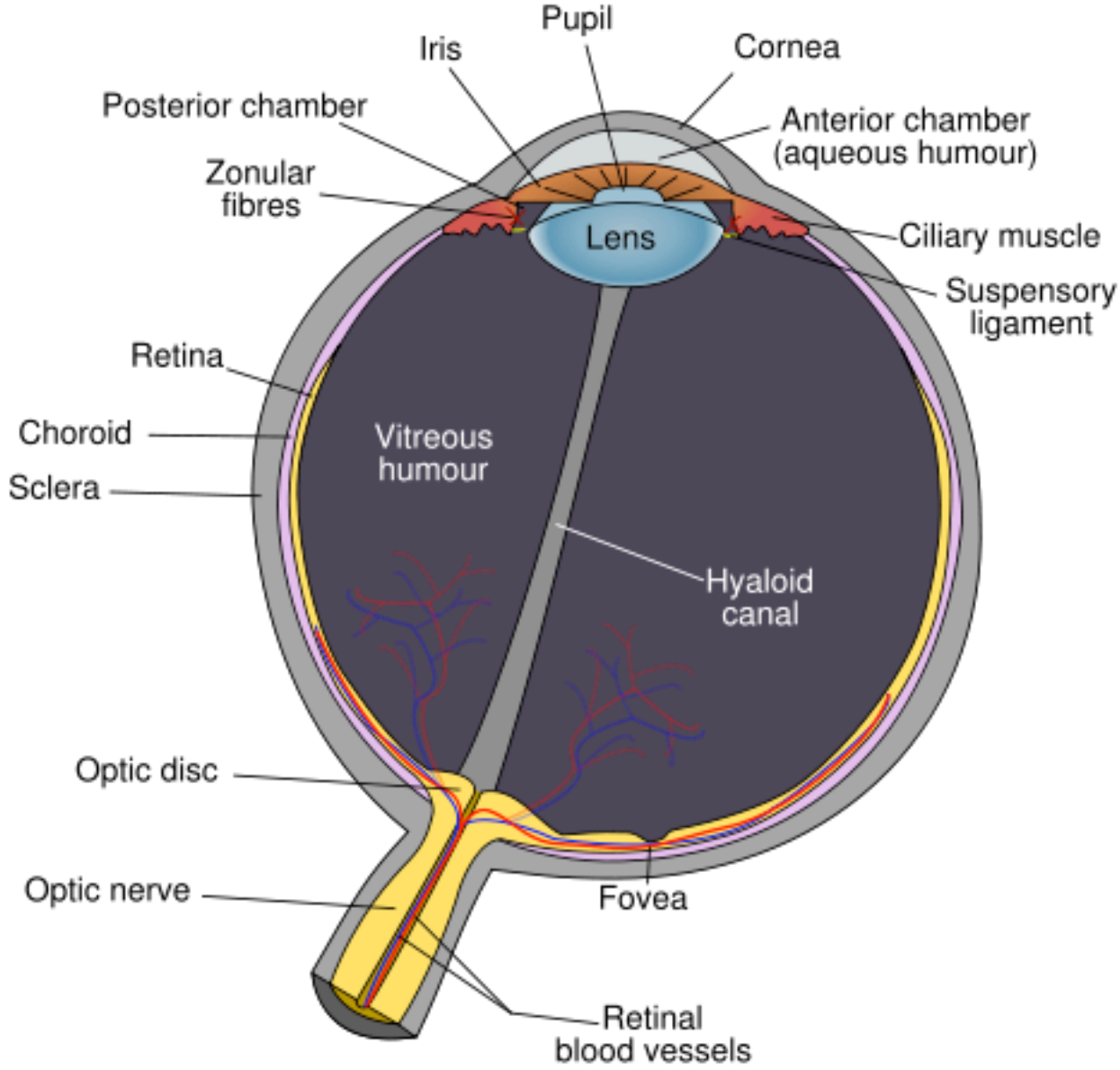
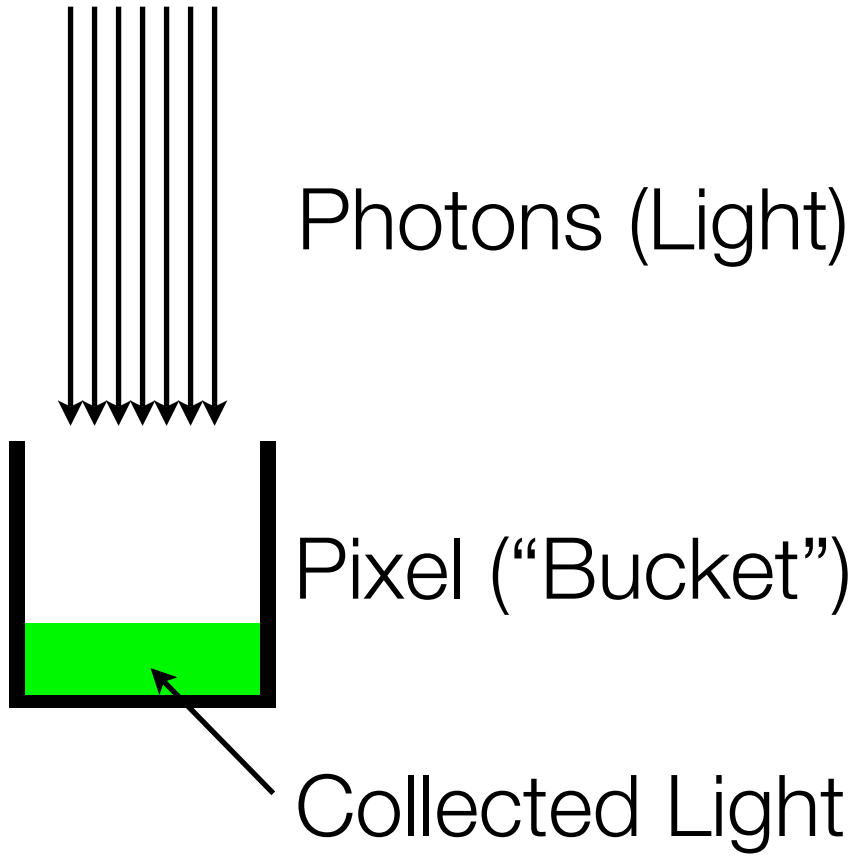


Image from http://en.wikipedia.org/wiki/Fovea

Dynamic Range

The Eye



Dynamic Range

Digital Cameras

$$\text{Dynamic Range} = \frac{\text{Biggest Signal (full “bucket”)}}{\text{Smallest detectable signal}}$$

1/80s, ISO 400, f/10

Photo by Dan Armendariz, 2006

Dynamic Range

In Scenes

Computer Science E-7
Exposing Digital Photography

Lecture 6: The Histogram
March 9, 2009

danallan@mit.edu