

Computer Science E-7

Exposing Digital Photography

Lecture 6: The Histogram
October 4, 2010

danallan@mit.edu

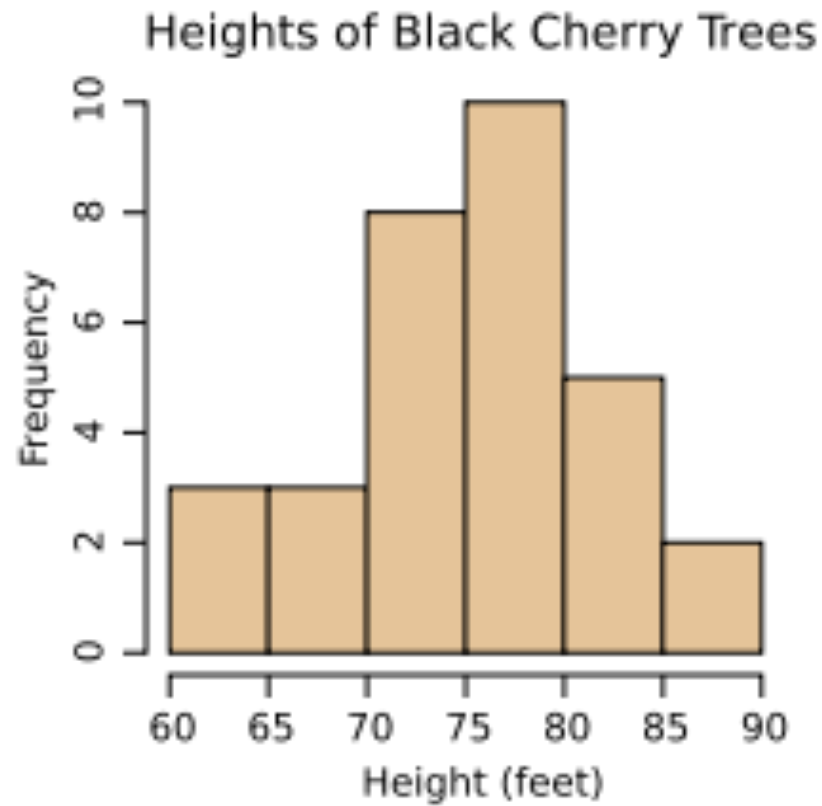
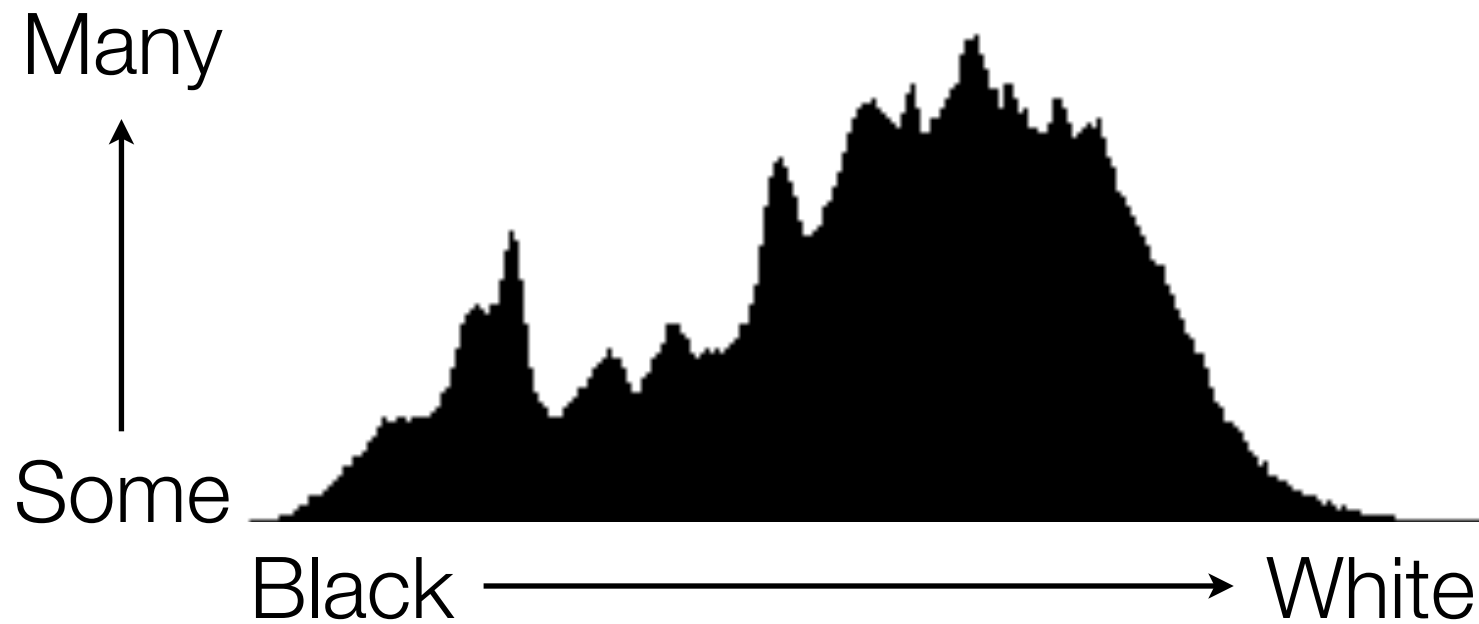


Image from <http://en.wikipedia.org/wiki/Histogram>

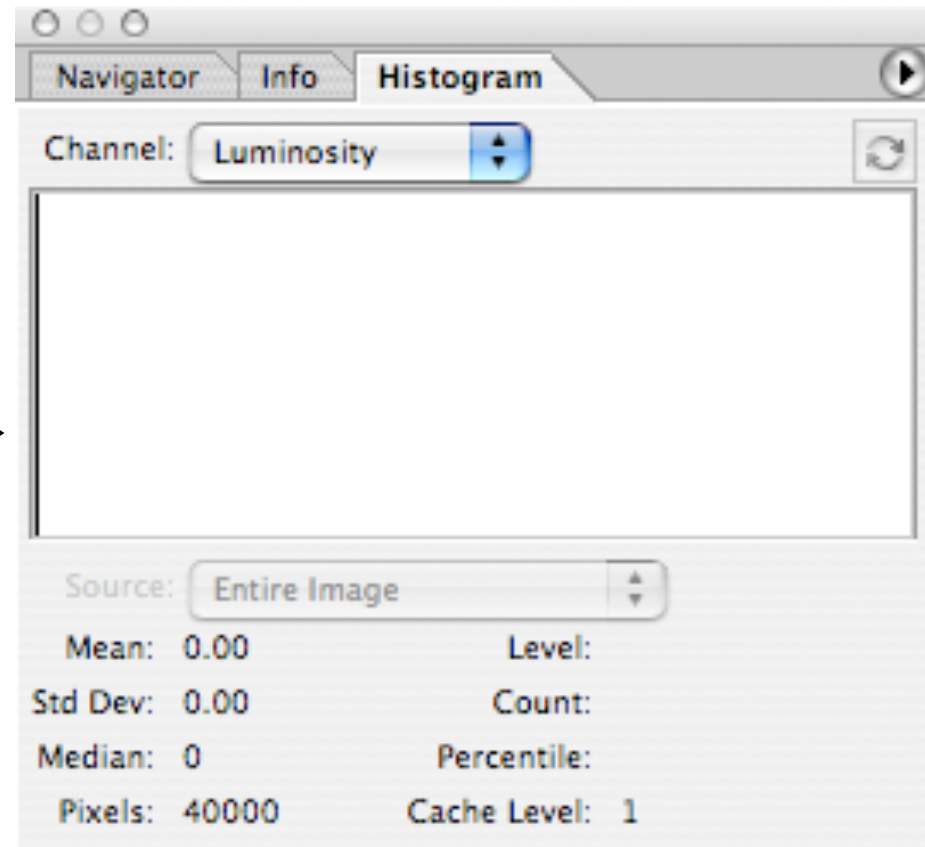
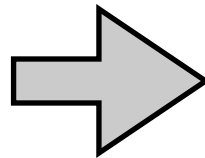
Histograms

General Histogram



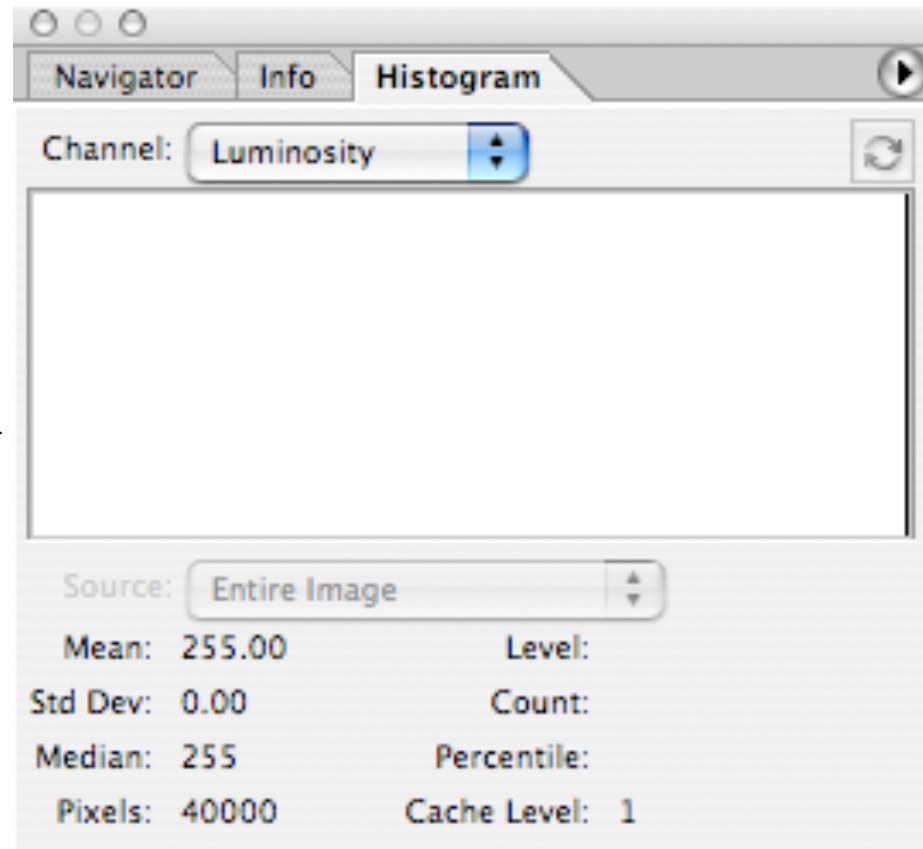
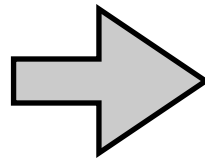
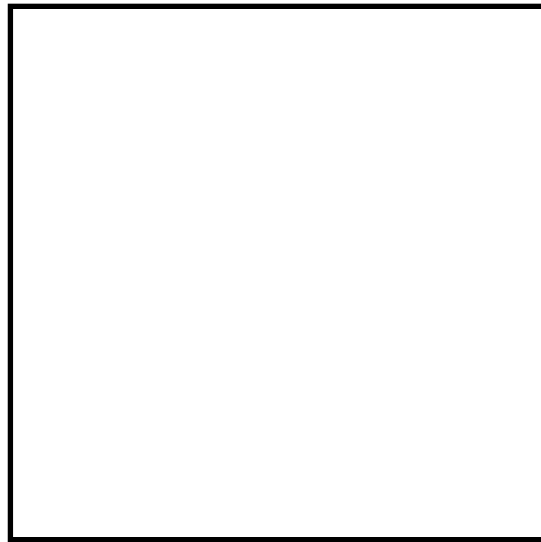
Histograms

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

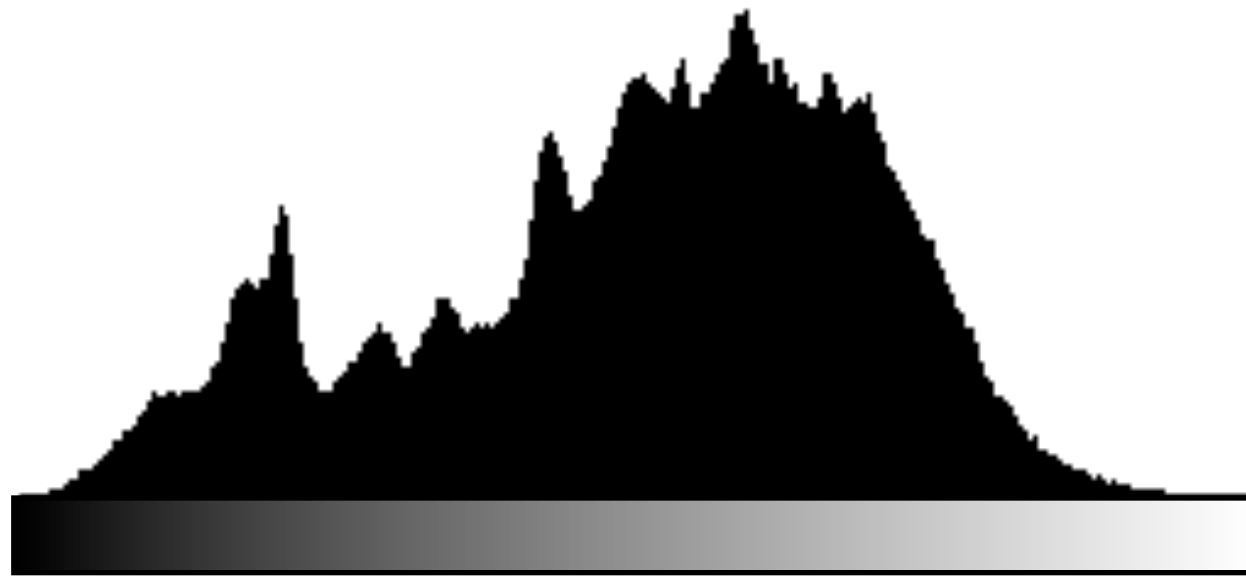
Histograms

Over- & Under-exposure

Bit	0 or 1
Byte	8 bits

Bits and Bytes

Refresher



Black —————> White
0 —————> 255

Bits and Bytes

As related to histograms

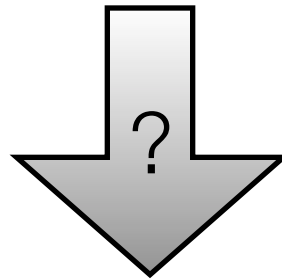
JPEG

Red	Green	Blue
8-bit	8-bit	8-bit
0255	0255	0255

Bits and Bytes

Bit Depth

Red	Green	Blue



Histograms

What about color?

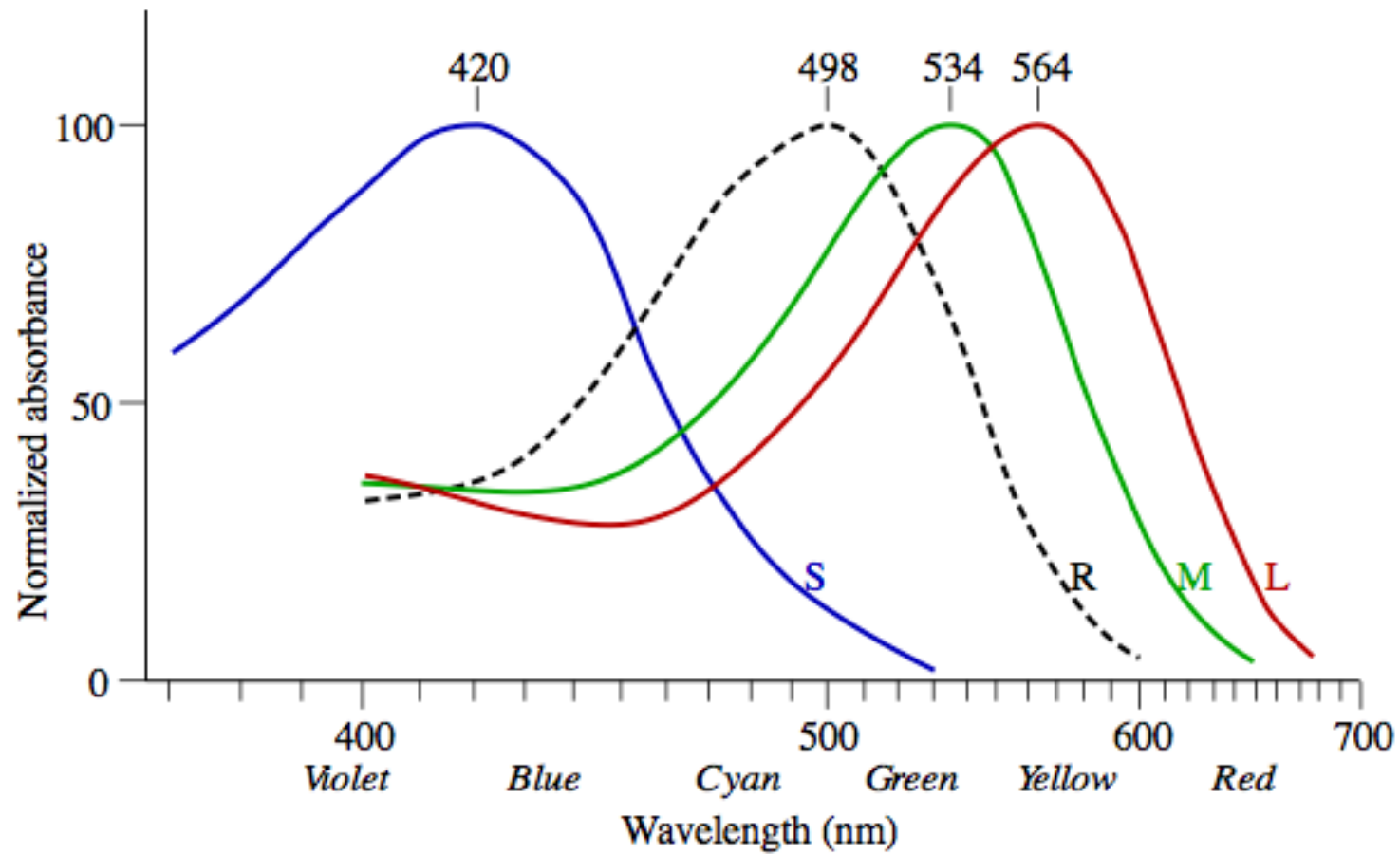


Image from <http://en.wikipedia.org/wiki/Trichromacy>

The Eye

Luminance Detection

Red	Green	Blue

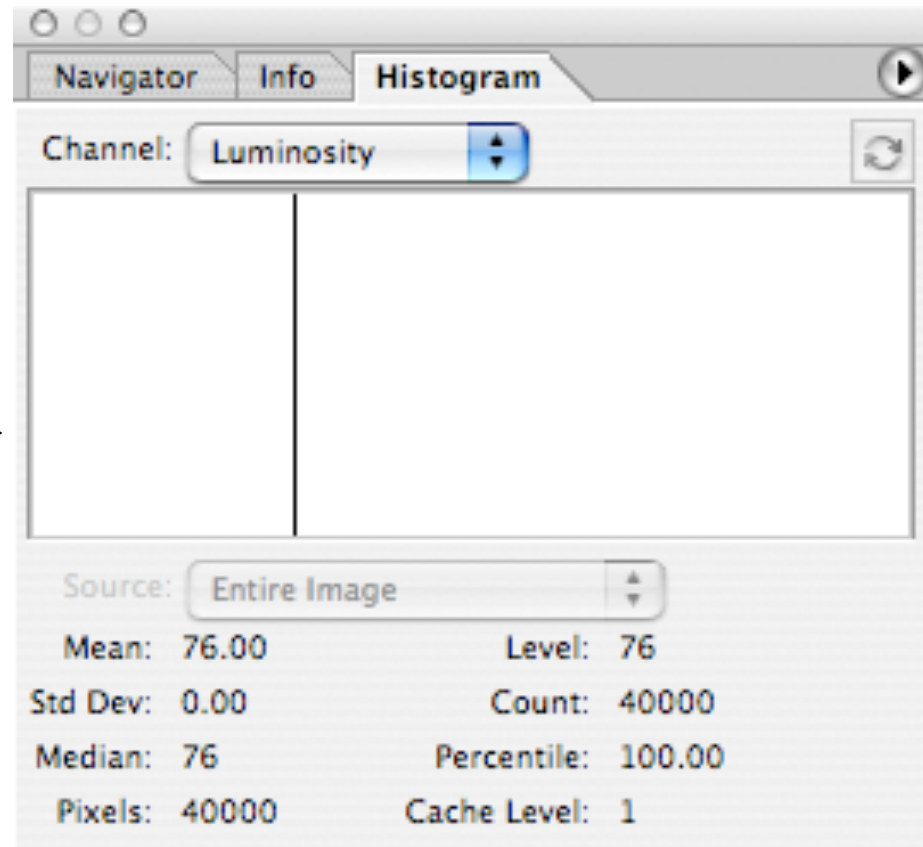
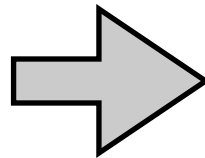
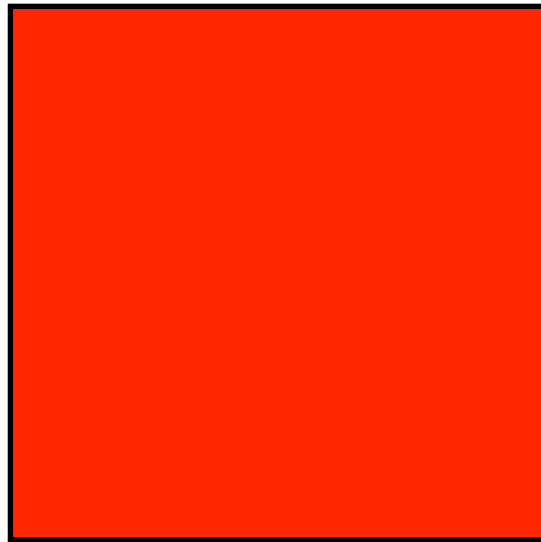
The Eye

Luminance Detection

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

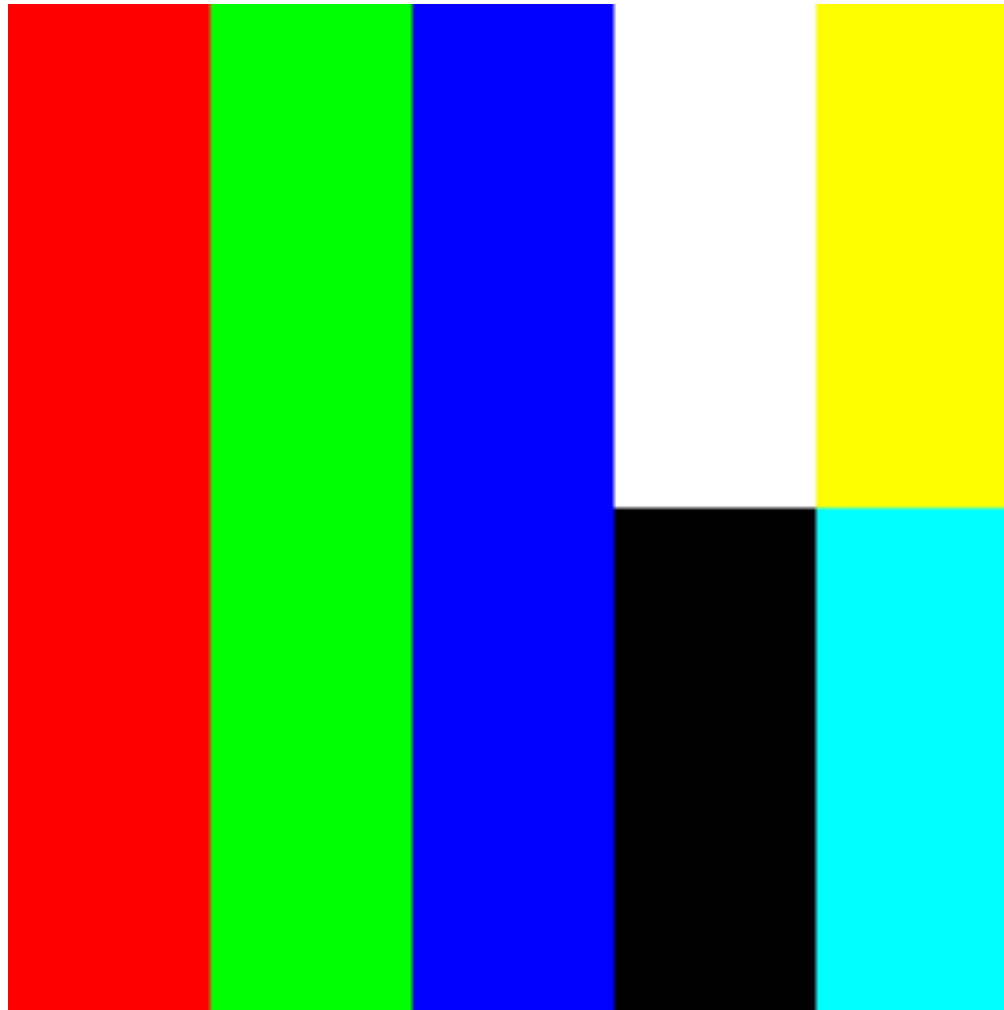
Luminance

Calculation



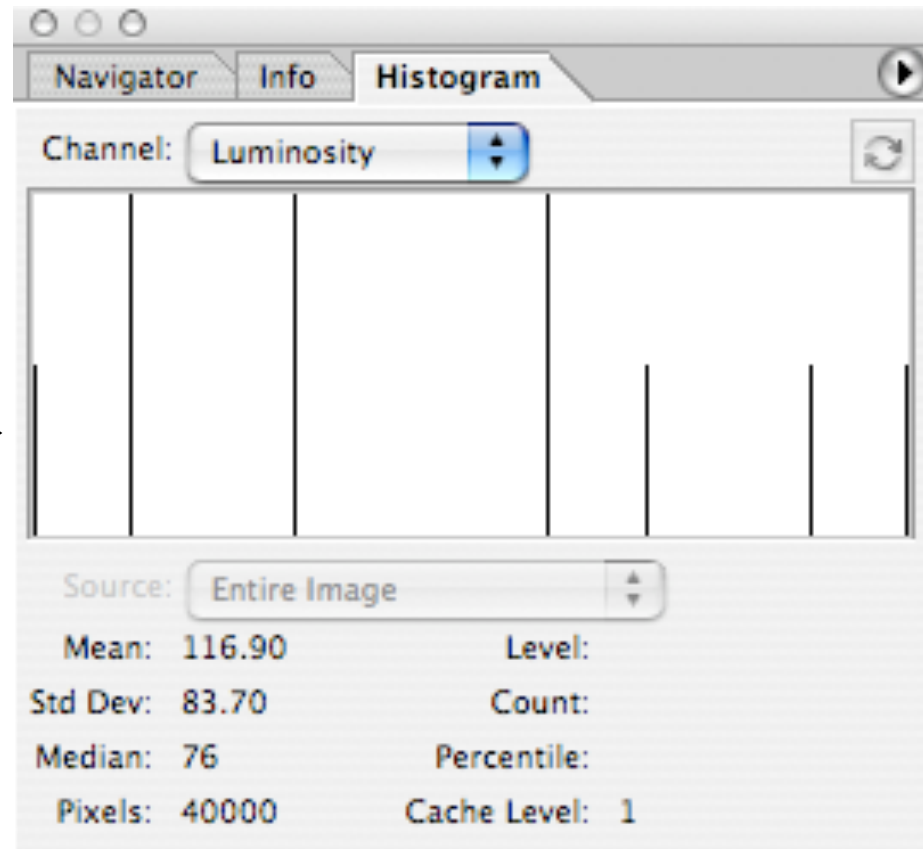
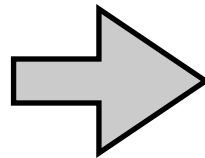
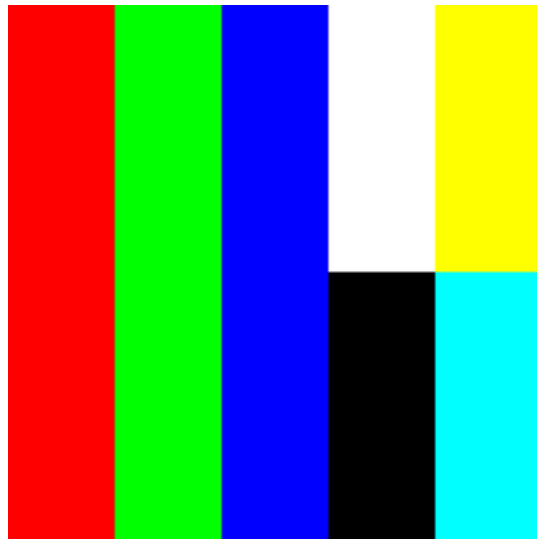
Luminosity Histograms

DIY!



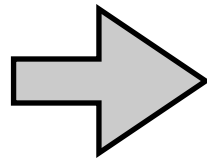
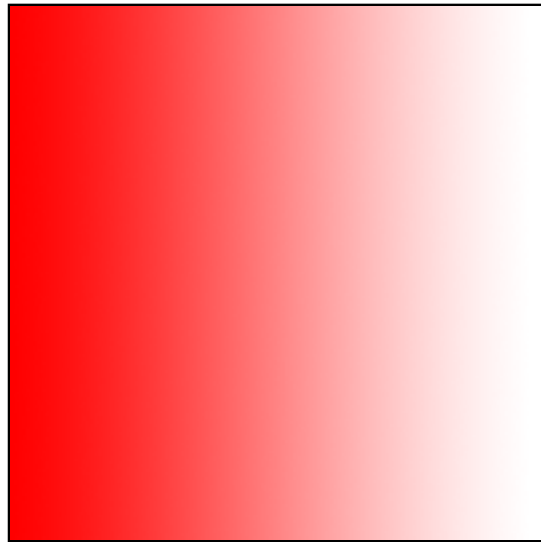
Luminosity Histograms

DIY!

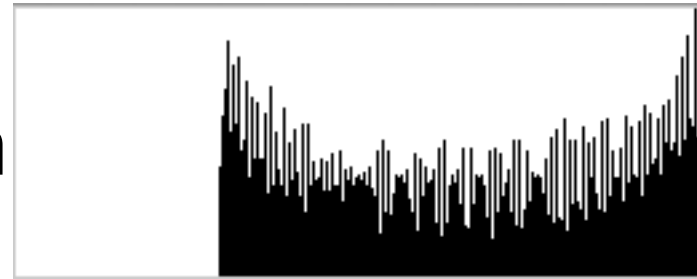


Luminosity Histograms

DIY!



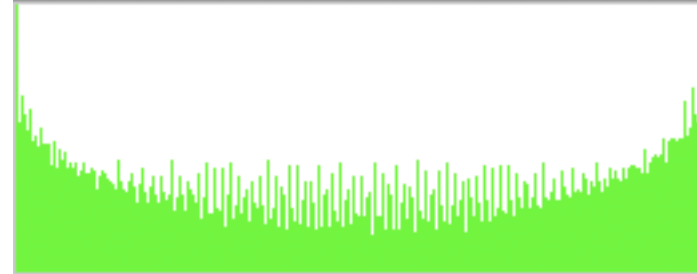
Lum



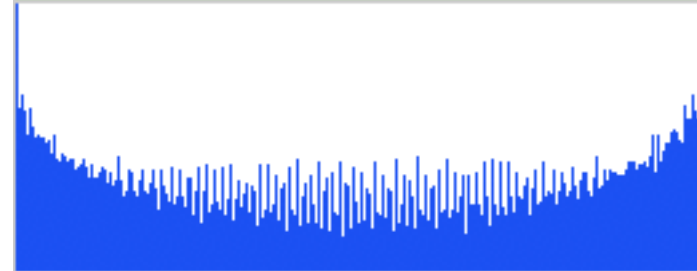
R



G

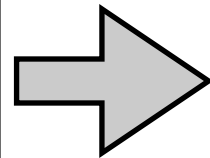
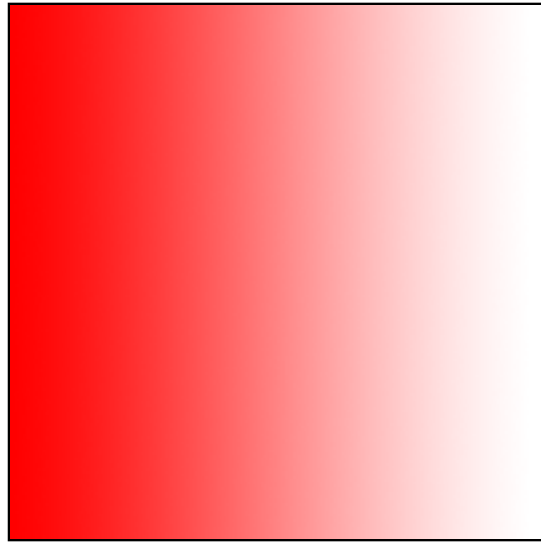


B

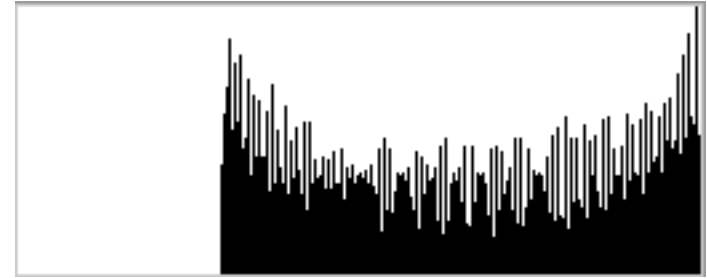


Histograms

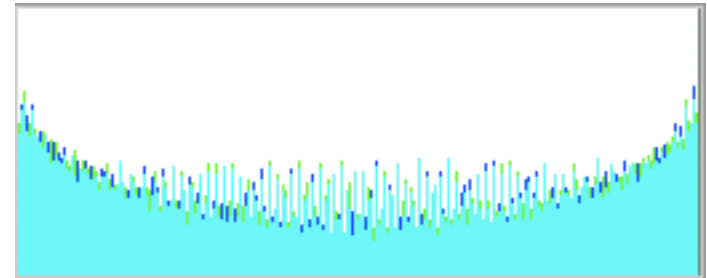
More than just Luminosity...



Lum



Colors

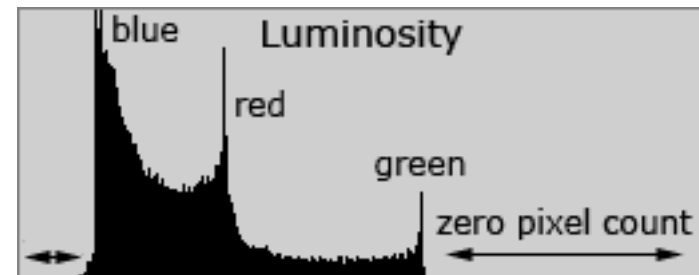
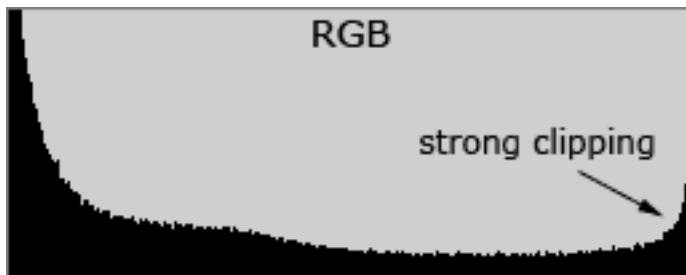
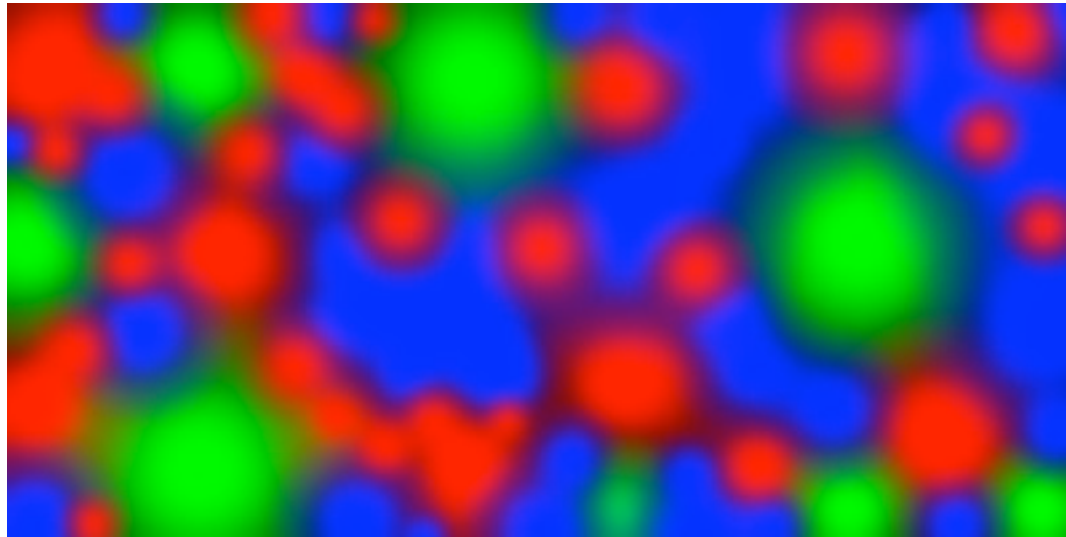


RGB



Histograms

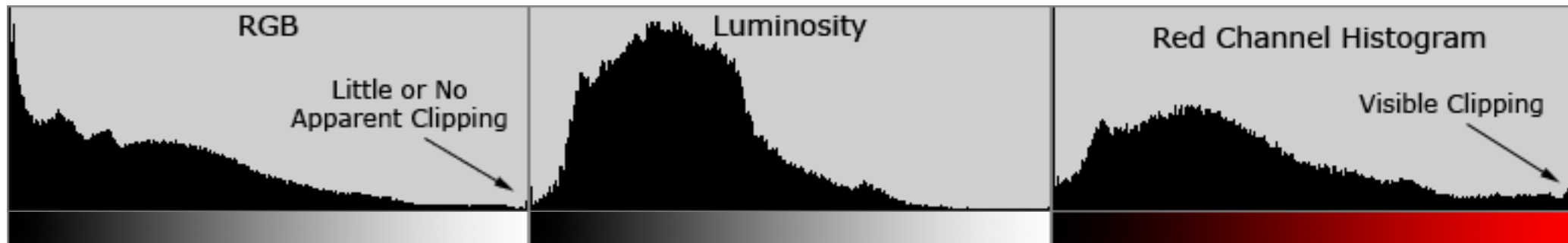
Luminosity, Colors, & RGB



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?

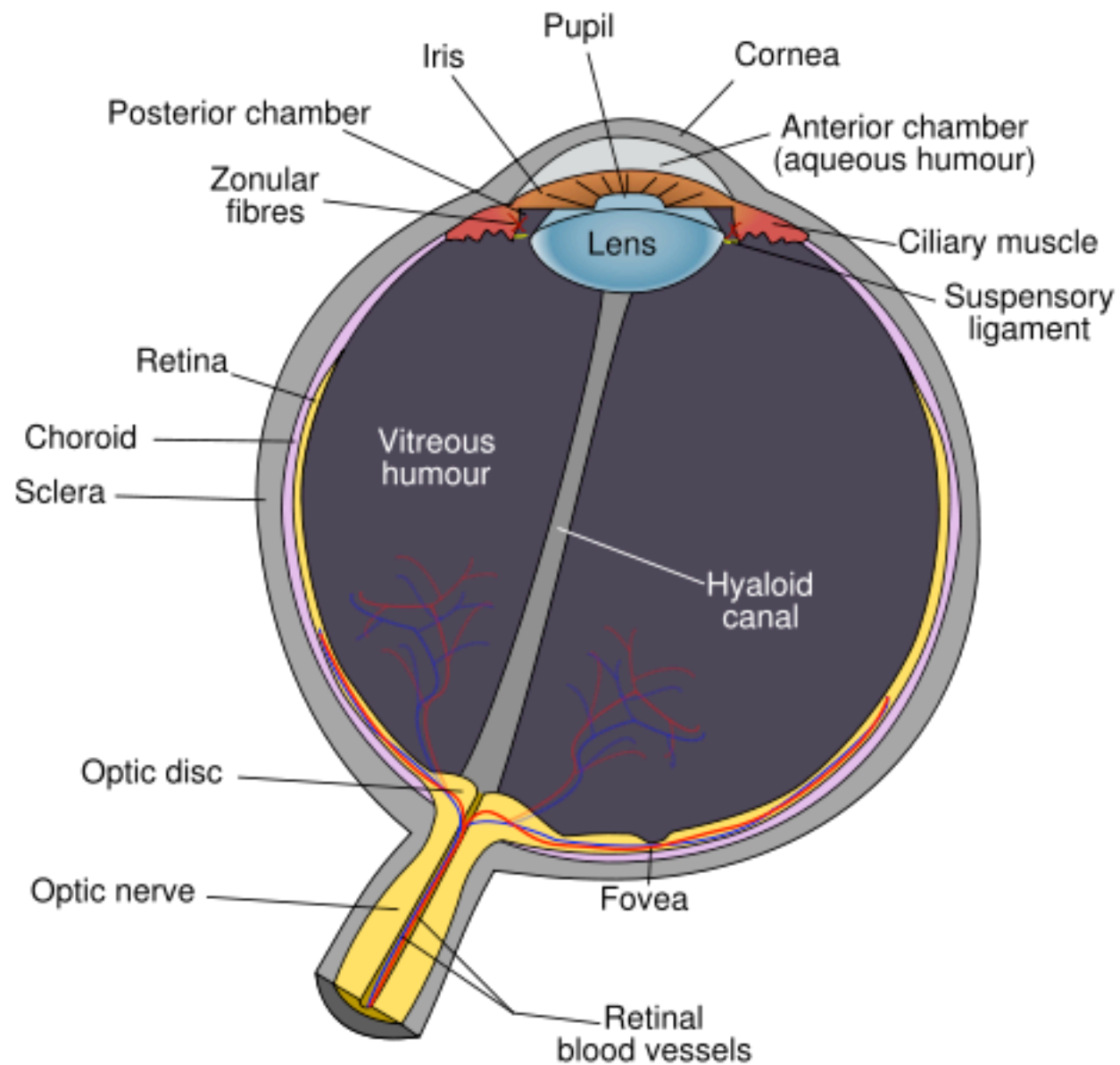
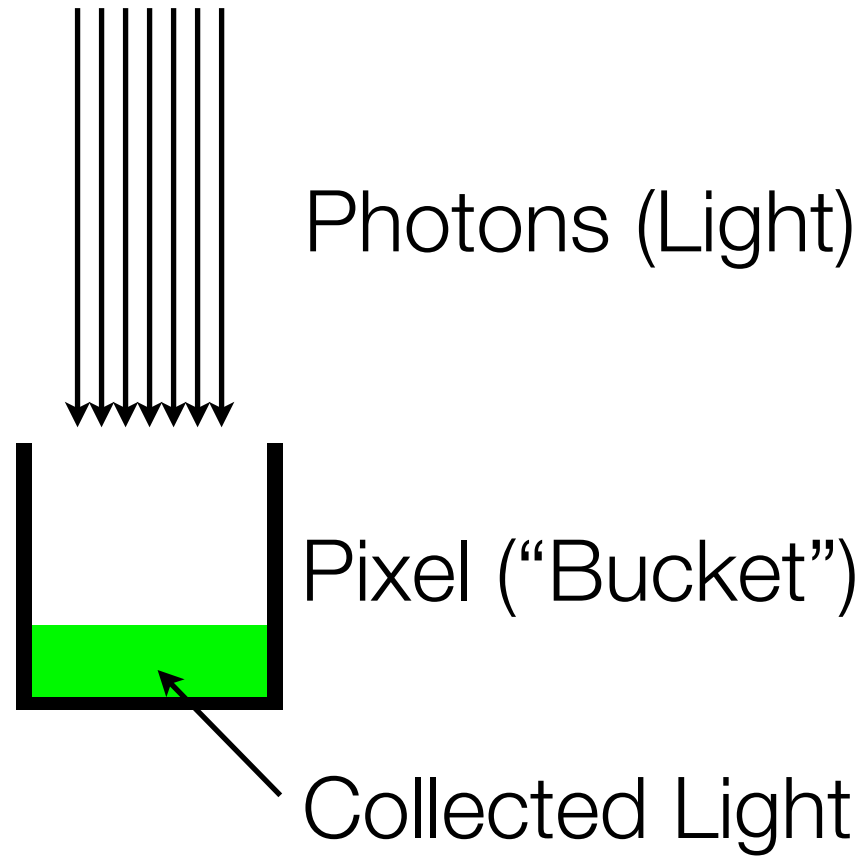


Image from <http://en.wikipedia.org/wiki/Fovea>

Dynamic Range

The Eye



Dynamic Range

Digital Cameras

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

Dynamic Range

Simplified Calculation



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
October 4, 2010

danallan@mit.edu