

# Computer Science E-7

## Exposing Digital Photography

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Lecture 6: The Histogram  
October 19, 2009

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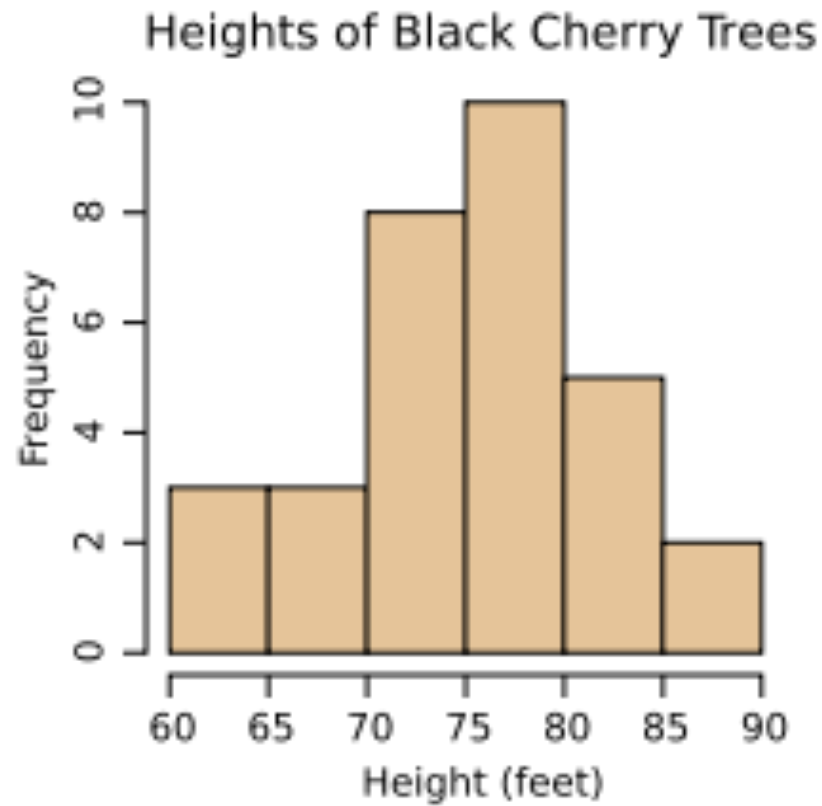
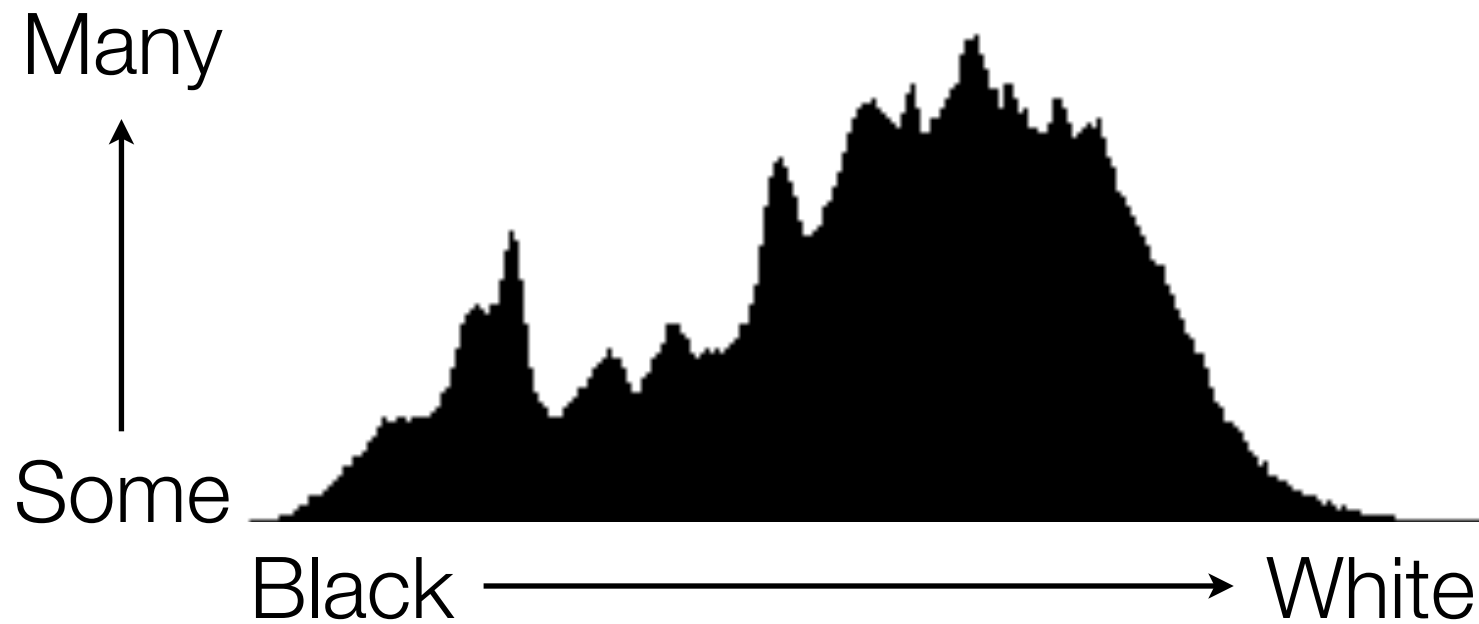


Image from <http://en.wikipedia.org/wiki/Histogram>

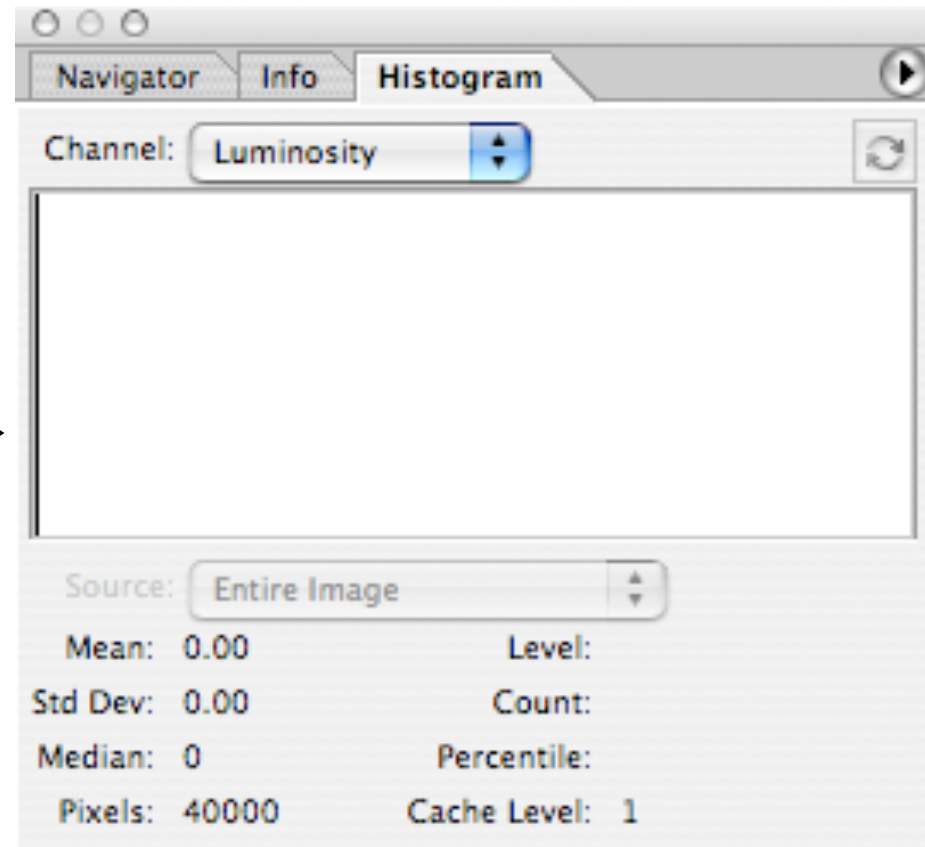
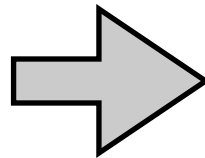
# Histograms

## General Histogram



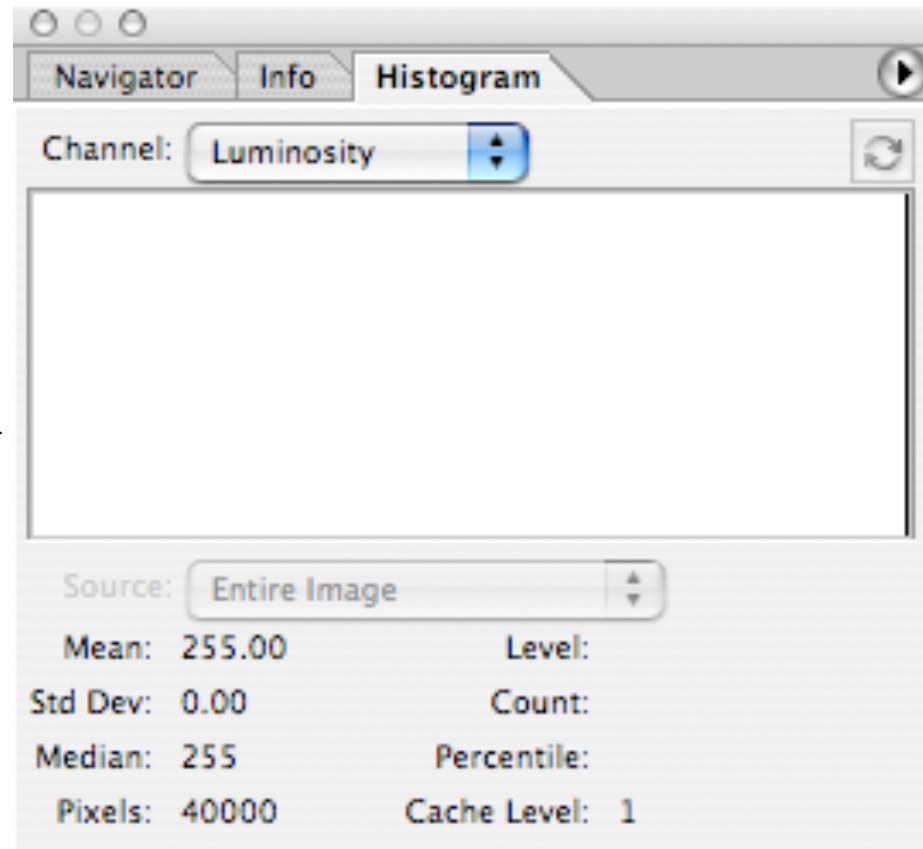
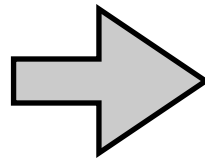
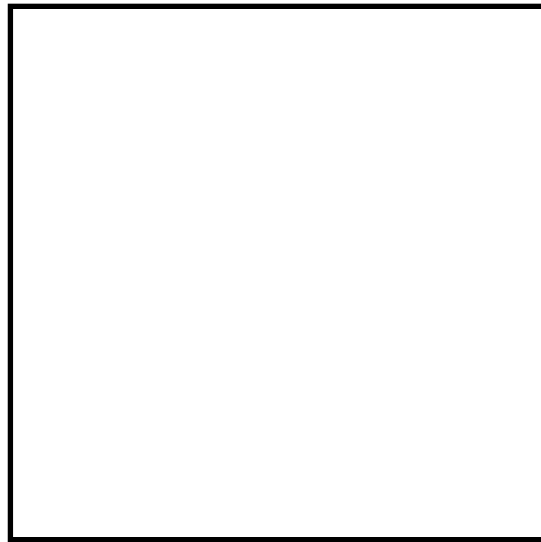
Histograms

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





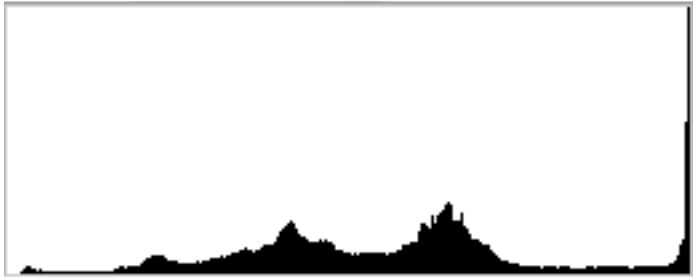
# Histograms

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Under-exposure

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





# Histograms

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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

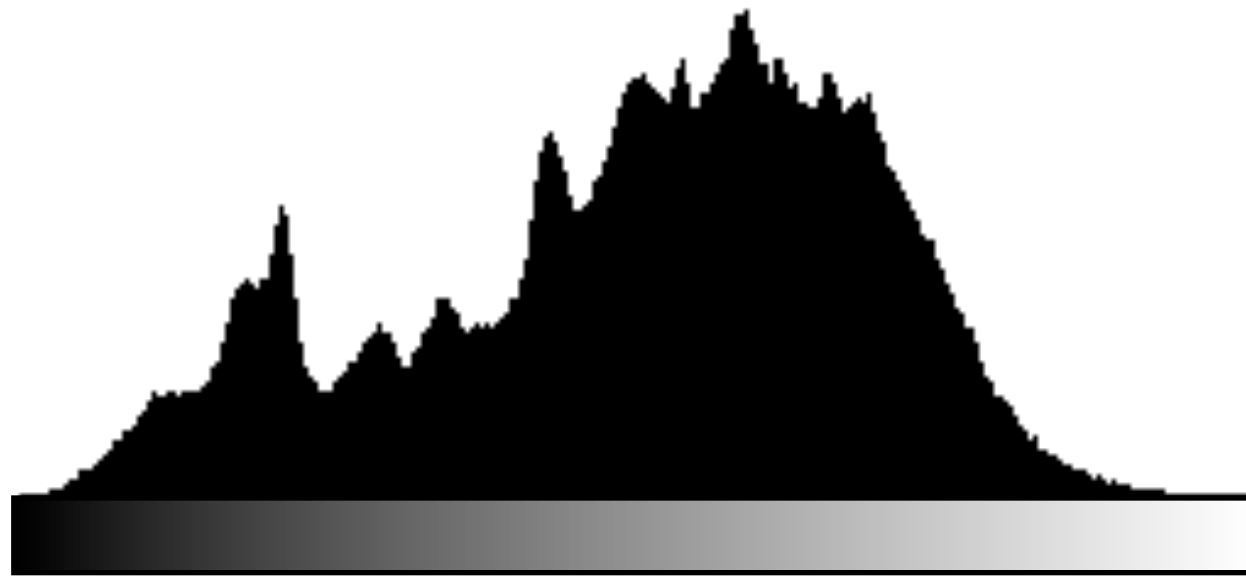
## Over- & Under-exposure



Bit	0 or 1
Byte	8 bits

Bits and Bytes

Refresher



Black —————> White  
0 —————> 255

Bits and Bytes

As related to histograms

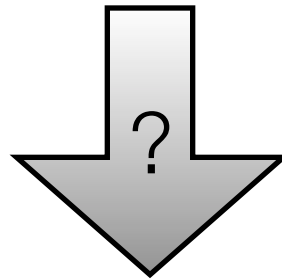
## JPEG

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

Bits and Bytes

Bit Depth

Red	Green	Blue



Histograms

What about color?



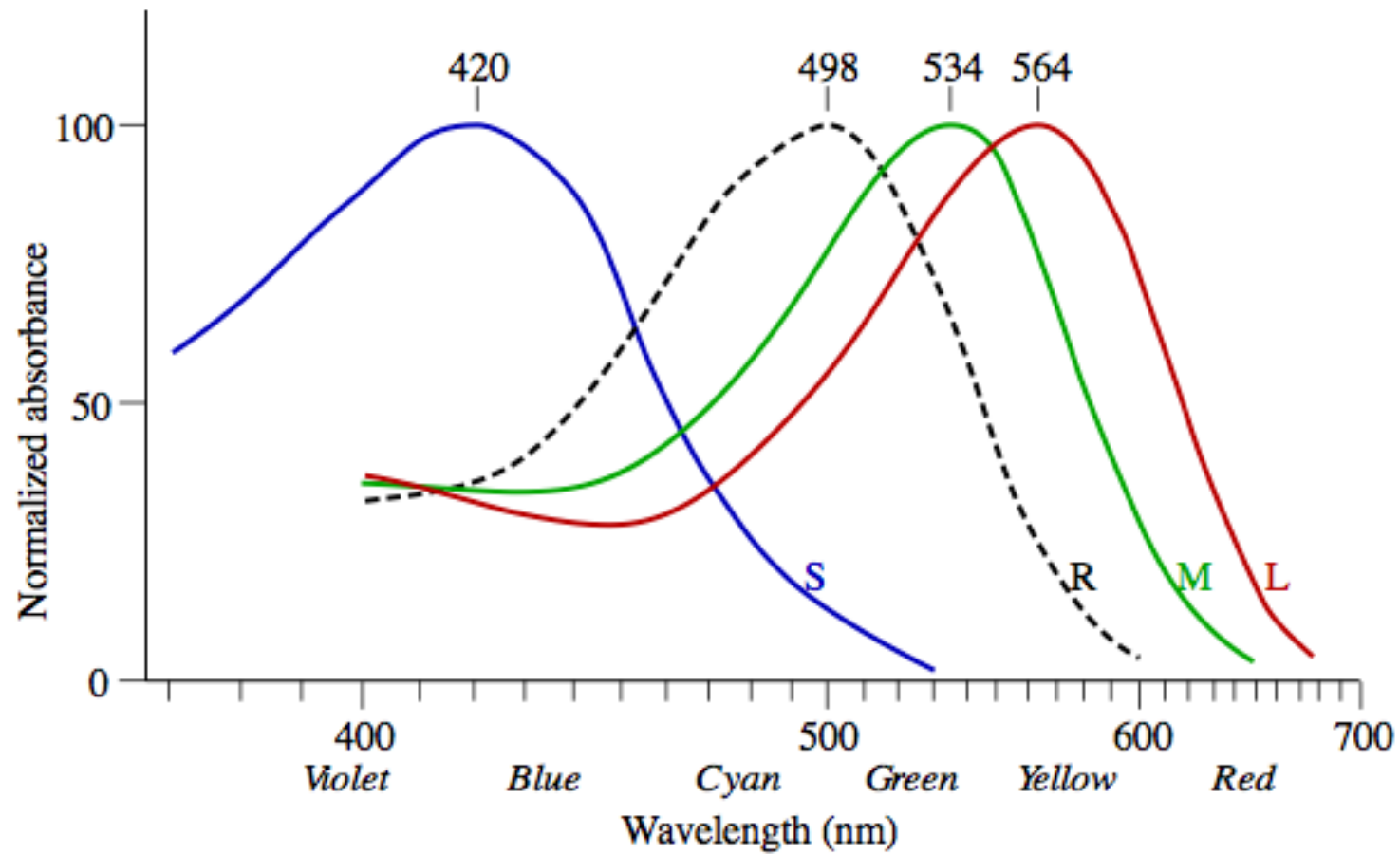


Image from <http://en.wikipedia.org/wiki/Trichromacy>

# The Eye

## Luminance Detection

Red	Green	Blue

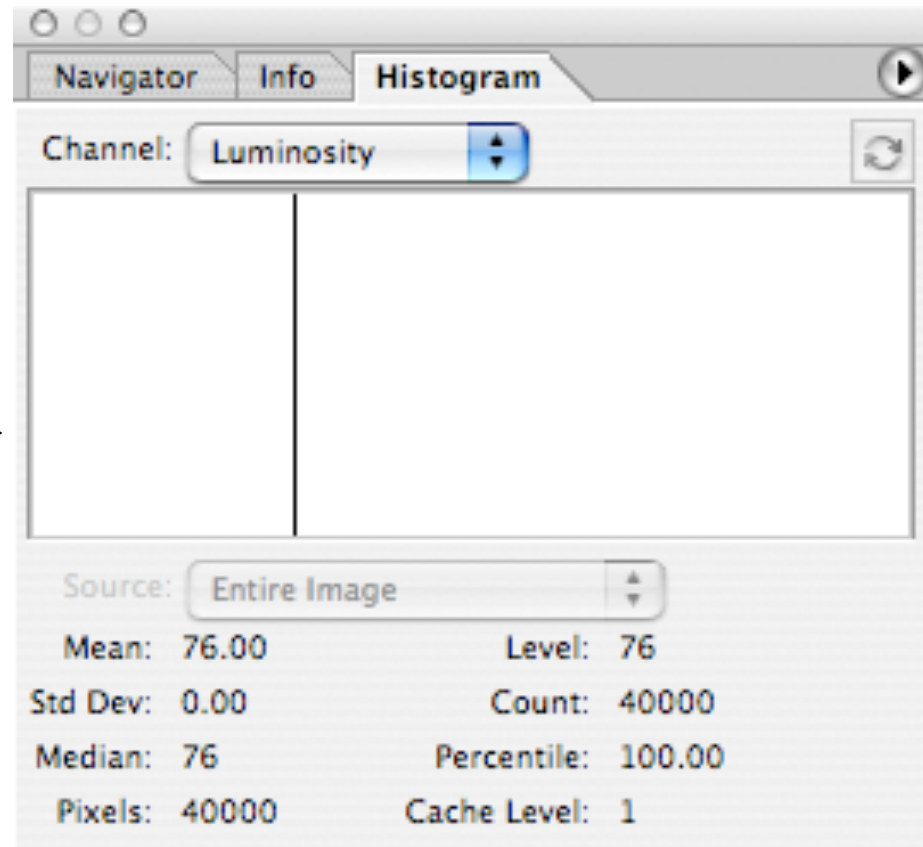
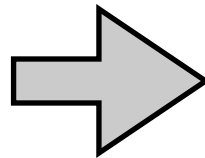
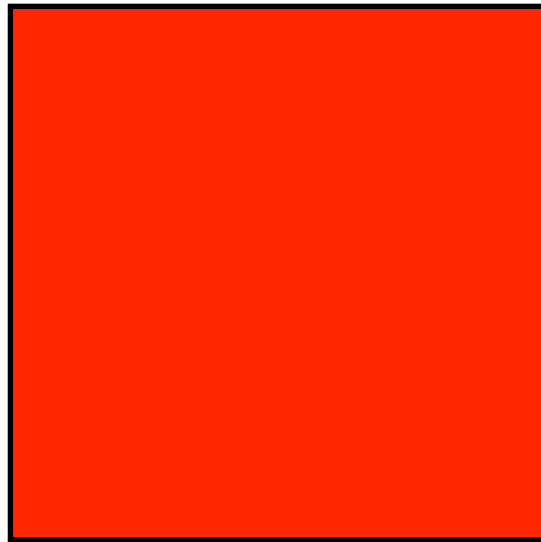
The Eye

Luminance Detection

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

Luminance

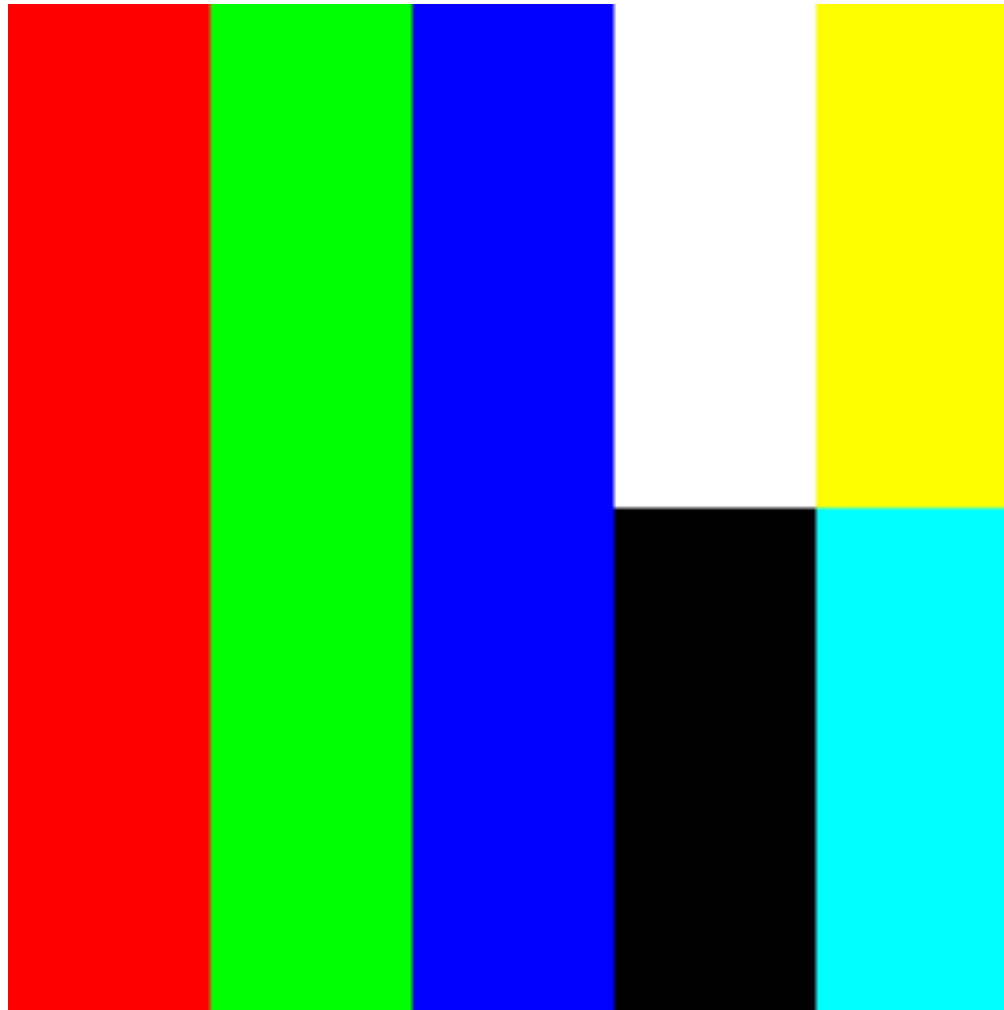
Calculation



# Luminosity Histograms

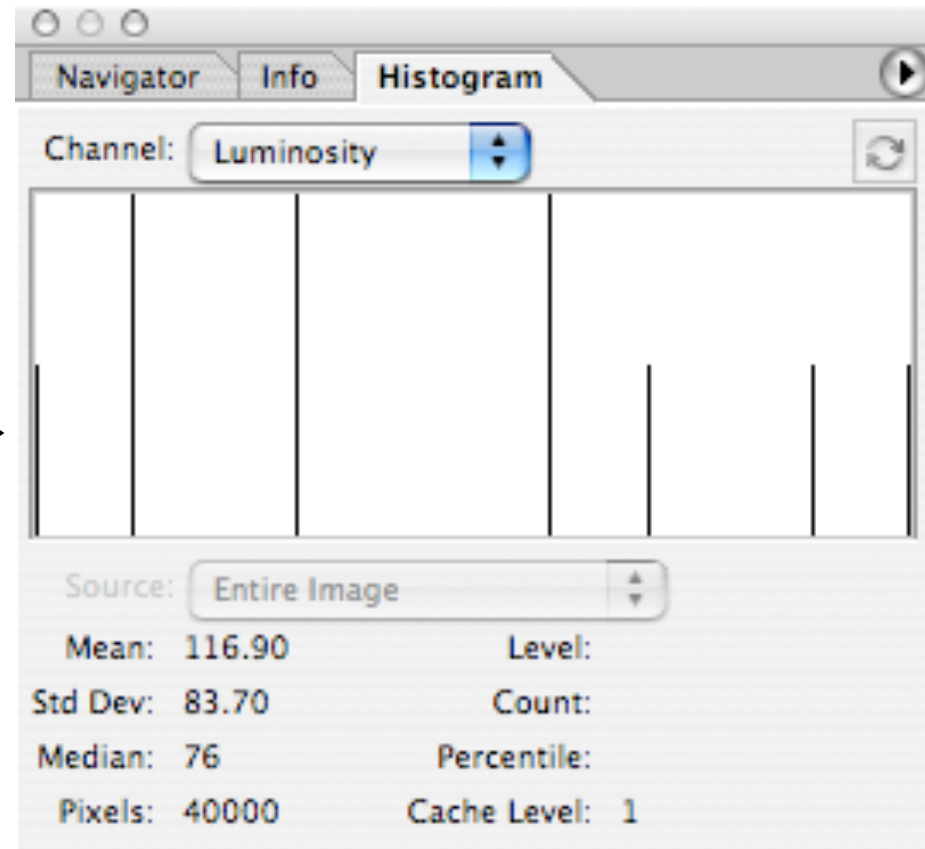
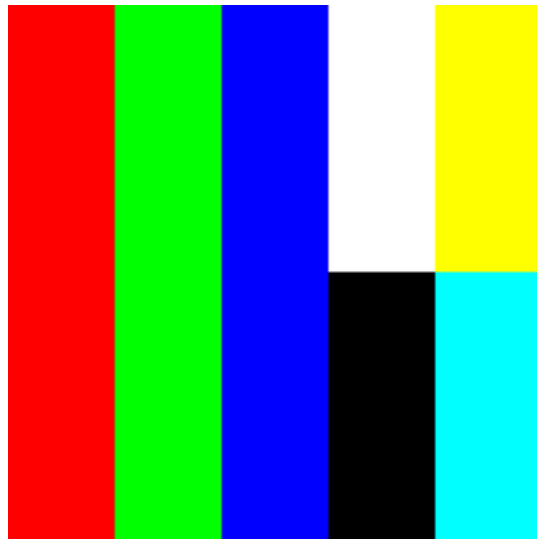
DIY!





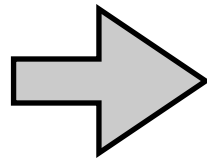
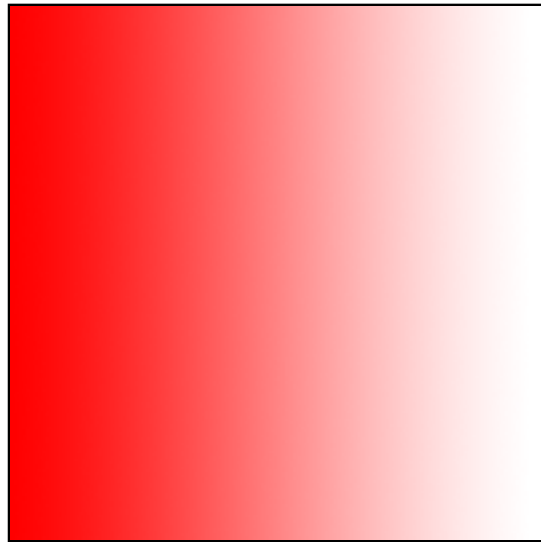
Luminosity Histograms

DIY!

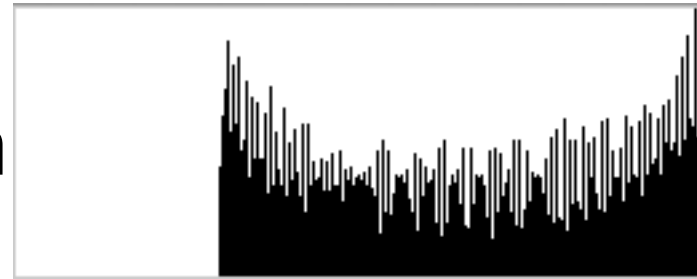


# Luminosity Histograms

DIY!



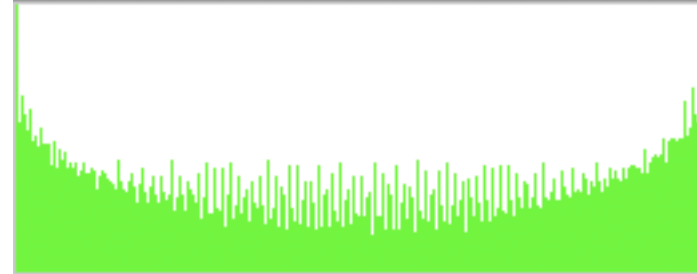
Lum



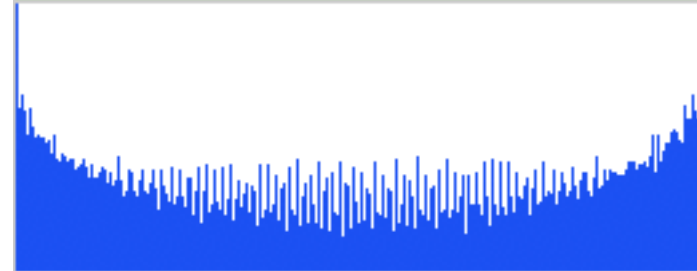
R



G

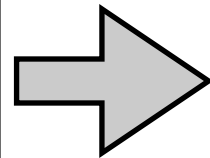
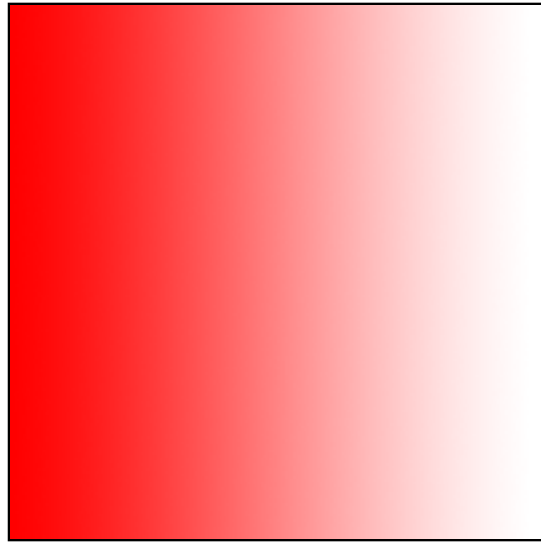


B



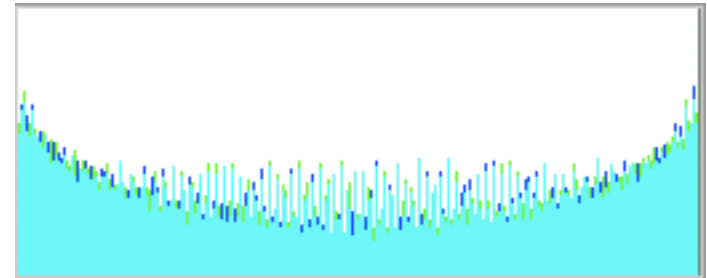
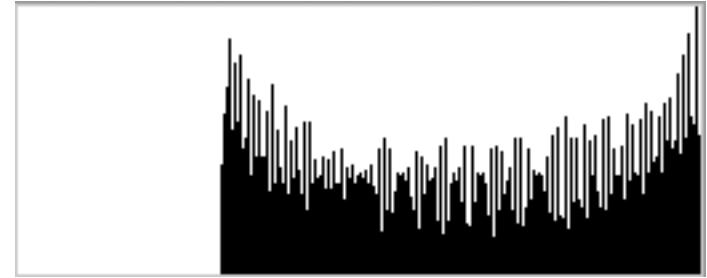
Histograms

More than just Luminosity...



Colors

Lum

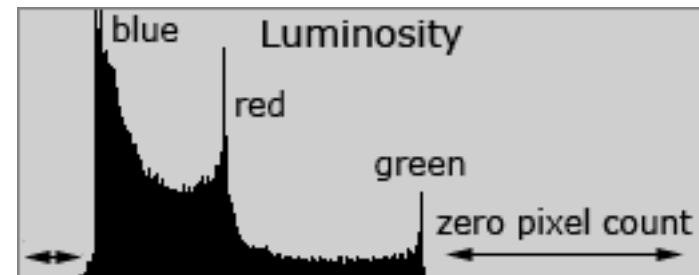
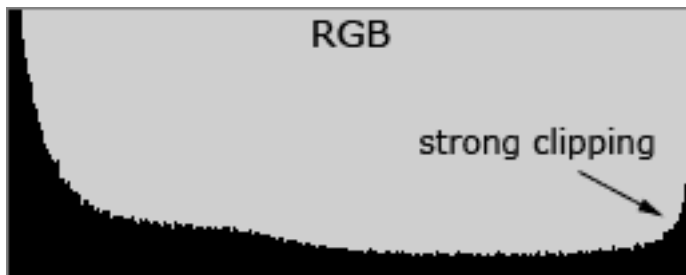
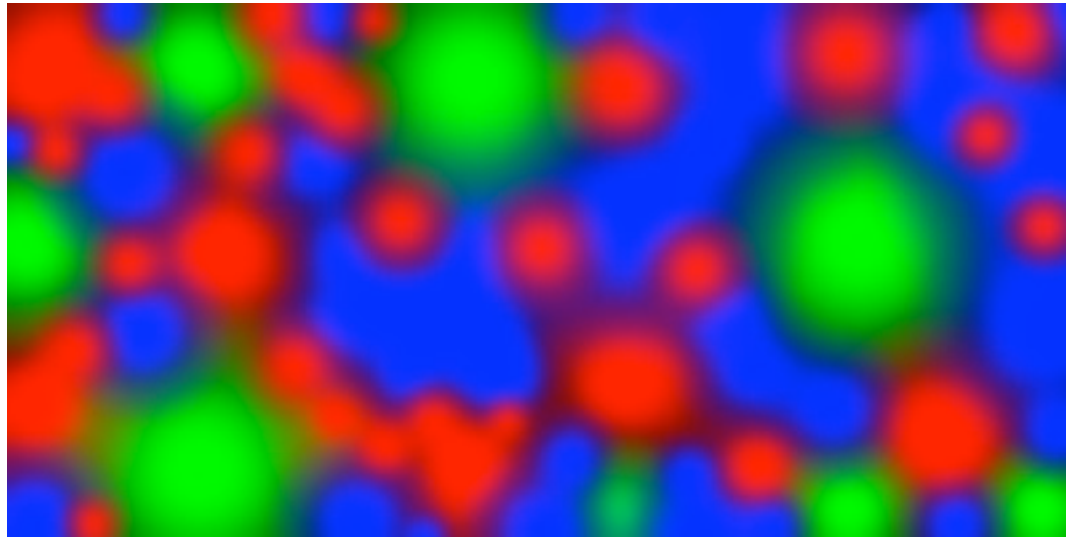


RGB



Histograms

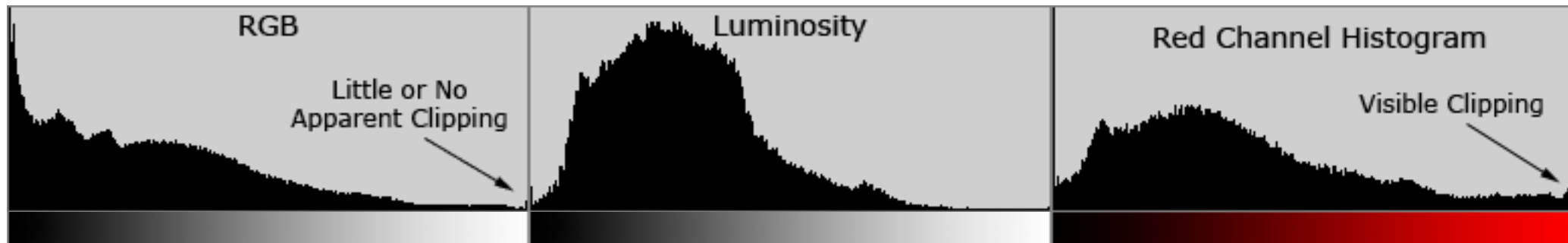
Luminosity, Colors, & RGB



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?

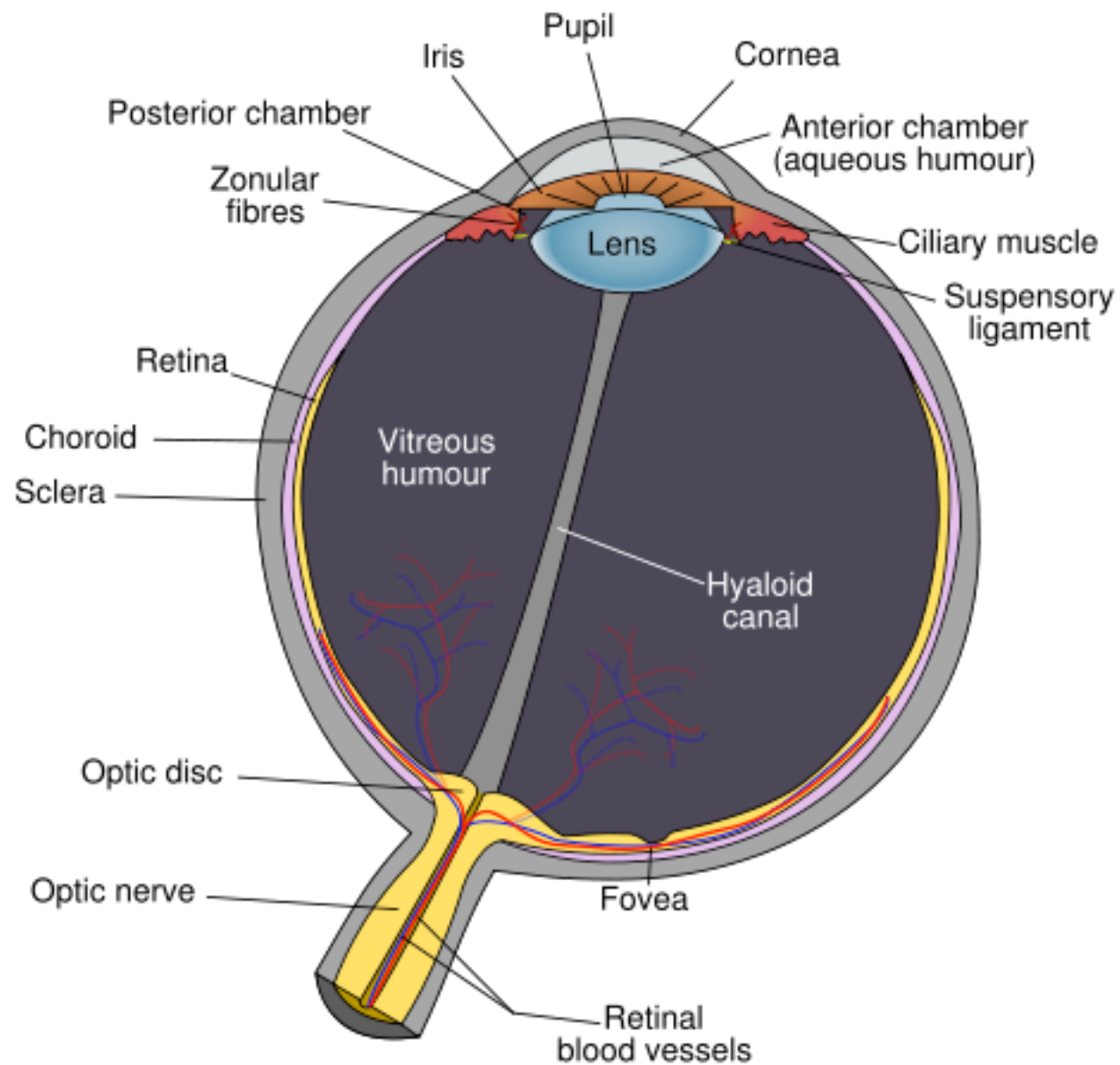
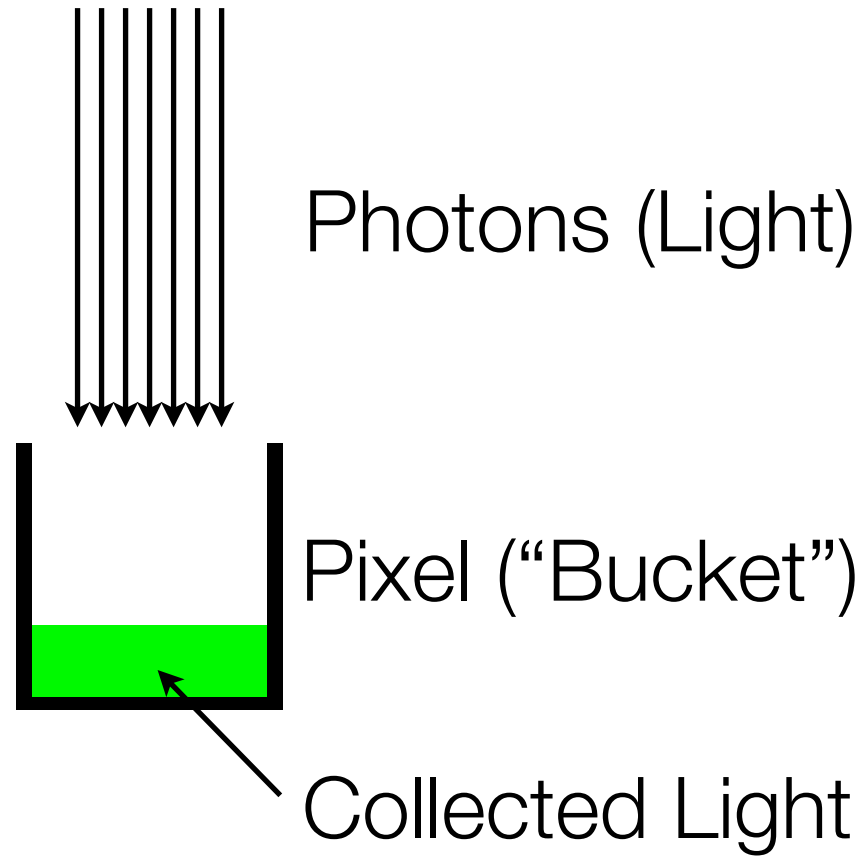


Image from <http://en.wikipedia.org/wiki/Fovea>

# 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

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October 19, 2009

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