Image Processing Introduction

Lecture Objectives:

1) Explain how an image is represented in memory.

2) Explain the concepts of RGB encoding.

3) Convert an RGB image into gray scale.

4) Convert an RGB image into HIS color space.

5) Explain what happens if a constant value is added or subtracted from a picture value.

6) Stretch and compress the contrast of an image.

7) Define the concept of convolution.

8) Using convolution blur the output of an image.

9) Using convolution, detect edges in an image.

10) Explain the purpose for median filtering of an image.

11) Construct an MPI program to calculate a Mandelbrot set.

- How is the following image represented in memory?

Array of
⌐ Bytes
└ Close

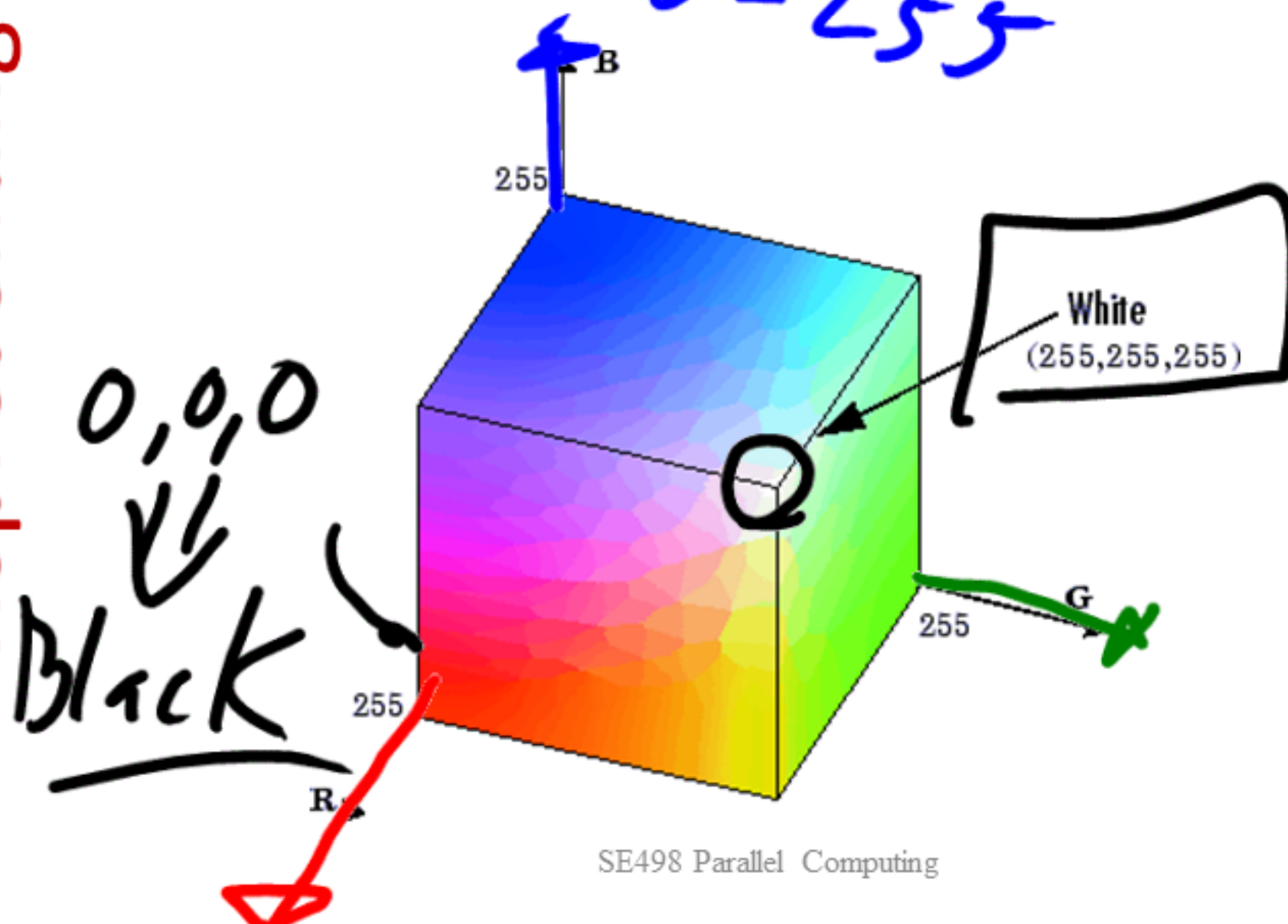Discussion

Bitmap?

3 #'s

R – 255
G – 0
B – 0

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Representing color

- RGB
  - Each pixel has 3 numbers associated with it
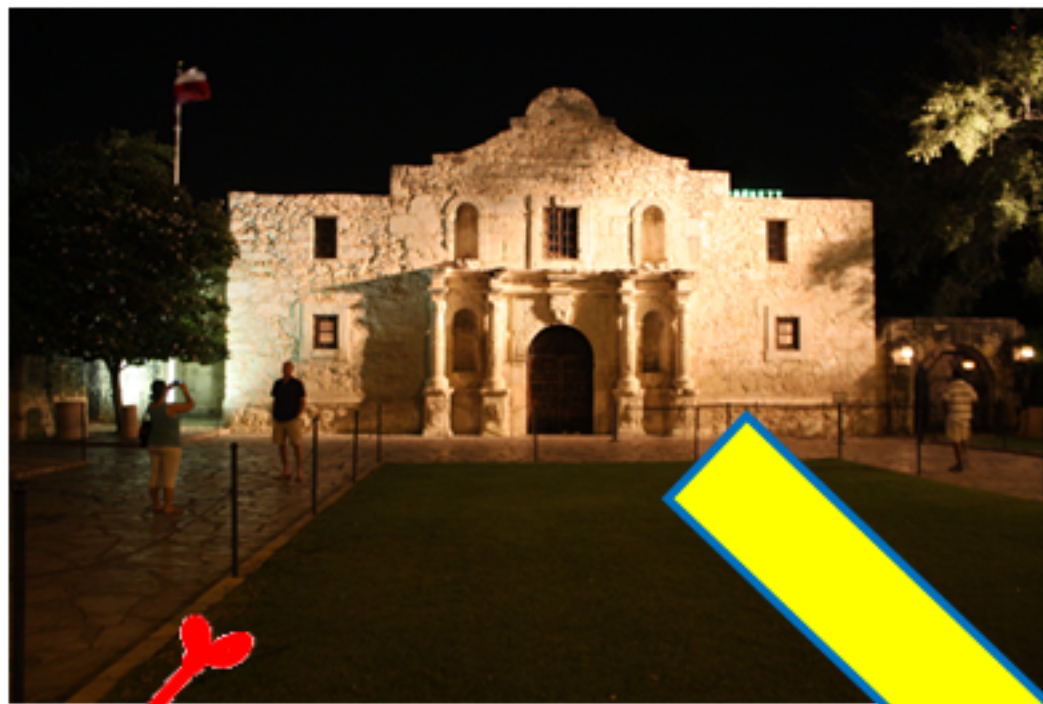   - R- Red — 0 – 255
    - G – Green 0 – 255
    - B – Blue 0 – 255

0,0,0
Black

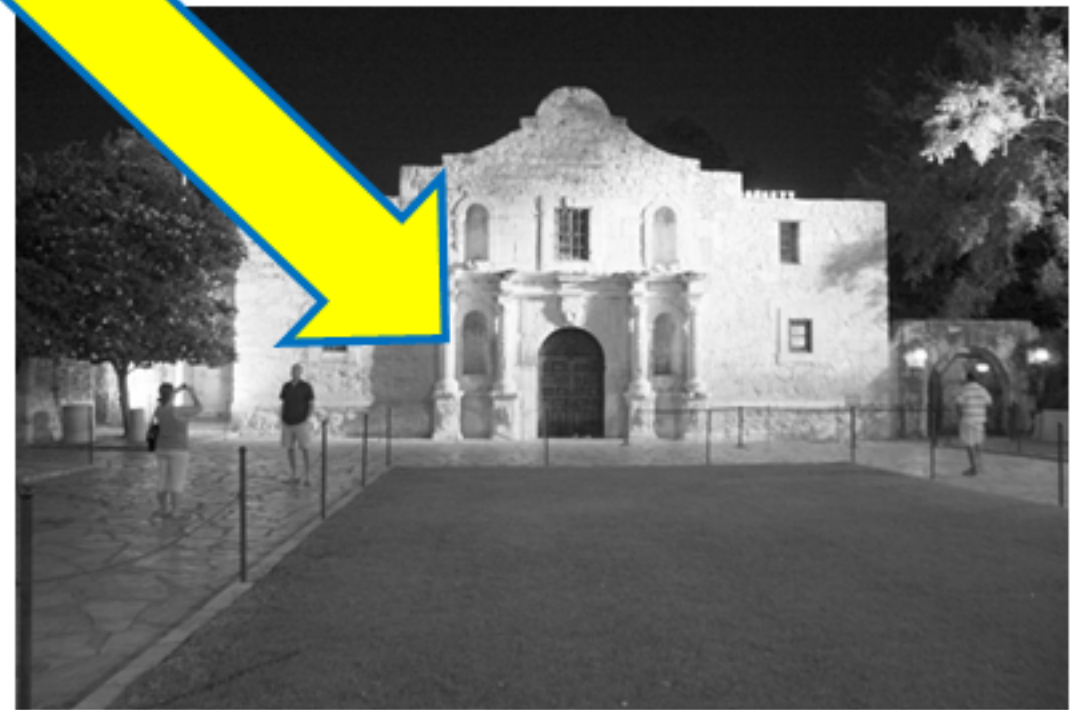255 **B**

255

255 **R**

G 255

White
(255,255,255)

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The eyes response to color

"A simplified approach to image processing"

SE498 Parallel Computing
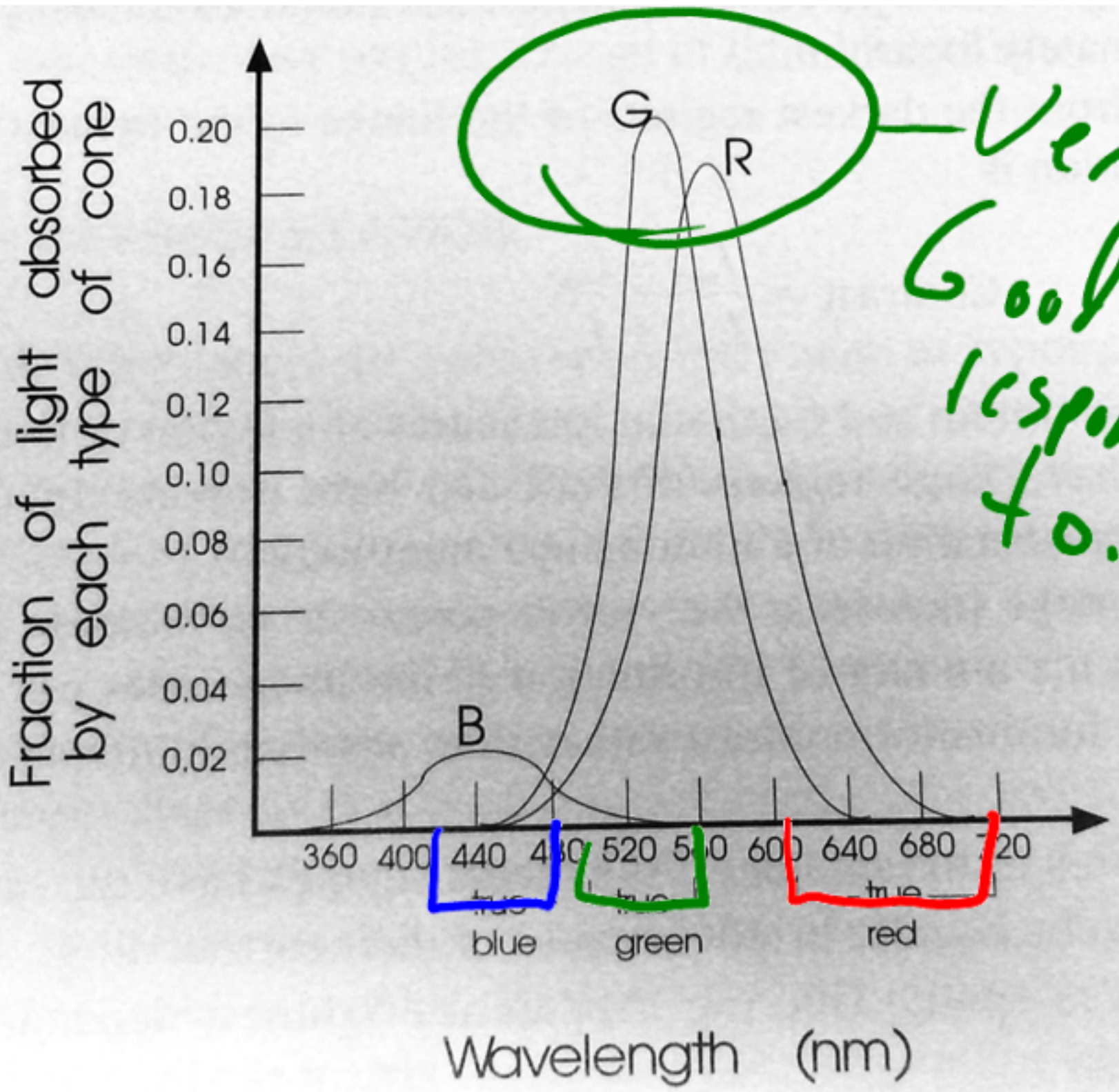
Converting an RGB image to grayscale

Color photo

RGB (+ this value.

← Equation

$$GrayScaleIntensity = 0.299R + 0.587G + 0.114B$$

SE498 Parallel Computing

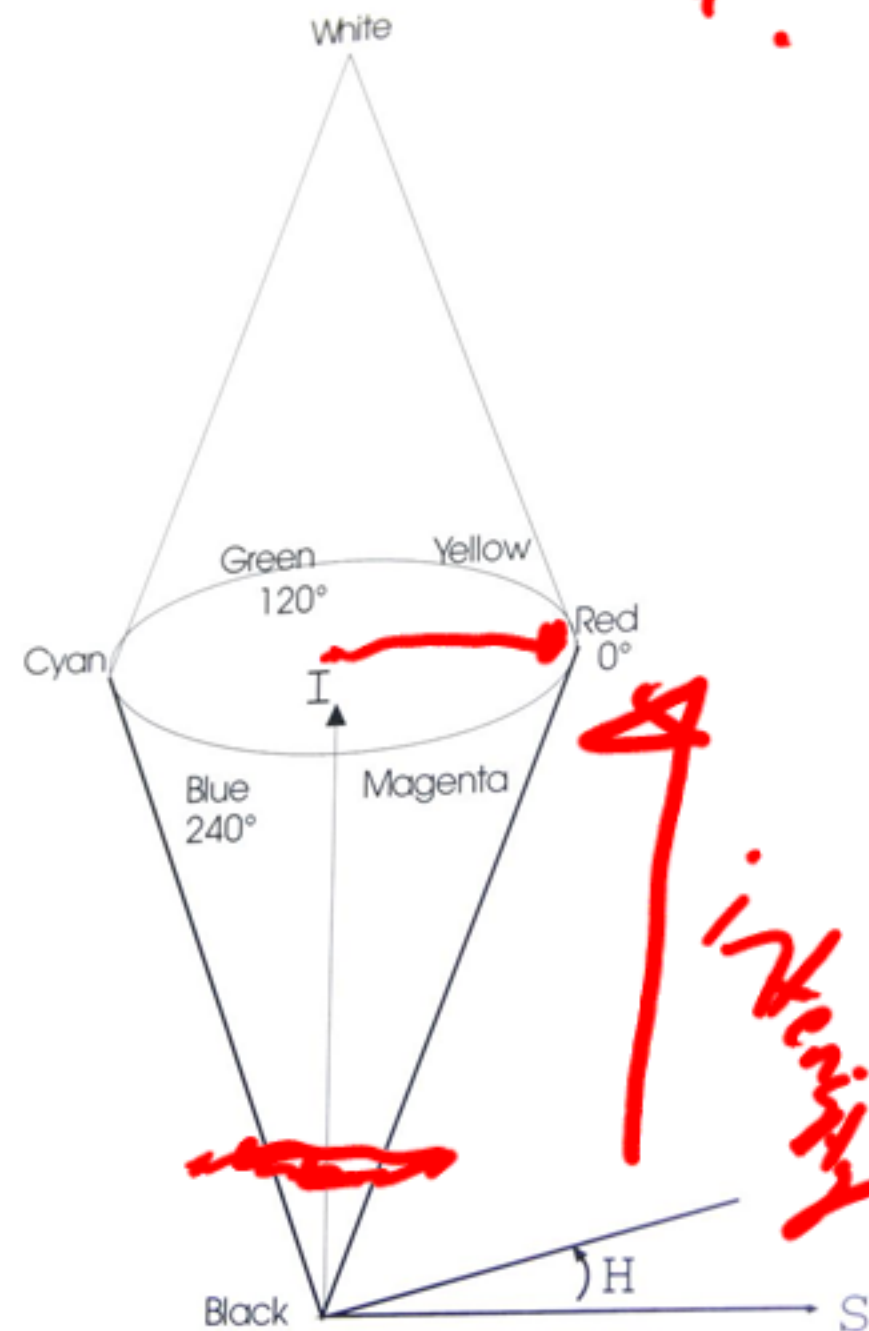# What is wrong with RGB?

→ Meaningless to humans.

→ Lots of storage

→ Hard to manipulate.

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HSI

- Hue
  - What general color is the area of the image

  R, G, B color in an area?

- Saturation
  - How strong is the color, from grayscale to full color

- Intensity
  - How bright is the color, from pure black to pure white

White

Green
120°
Yellow

Cyan

Red
0°

I

Blue
240°
Magenta

intensity

Black

)H

S

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- Cylindrical coordinates
  - Hue is an angle between 0 and 360
  - Saturation is a radius between 0 and 1
  - Intensity is a value between 0 and 1.

$$I = \frac{1}{3}(R + G + B)$$

$$S = 1 - \frac{3}{(R + G + B)}[\min(R.G.B)]$$

$$H = \cos^{-1}\left[\frac{\frac{1}{2}[(R - G) + (R - B)]}{\sqrt{(R - G)^2 + (R - B)(G - B)}}\right]$$

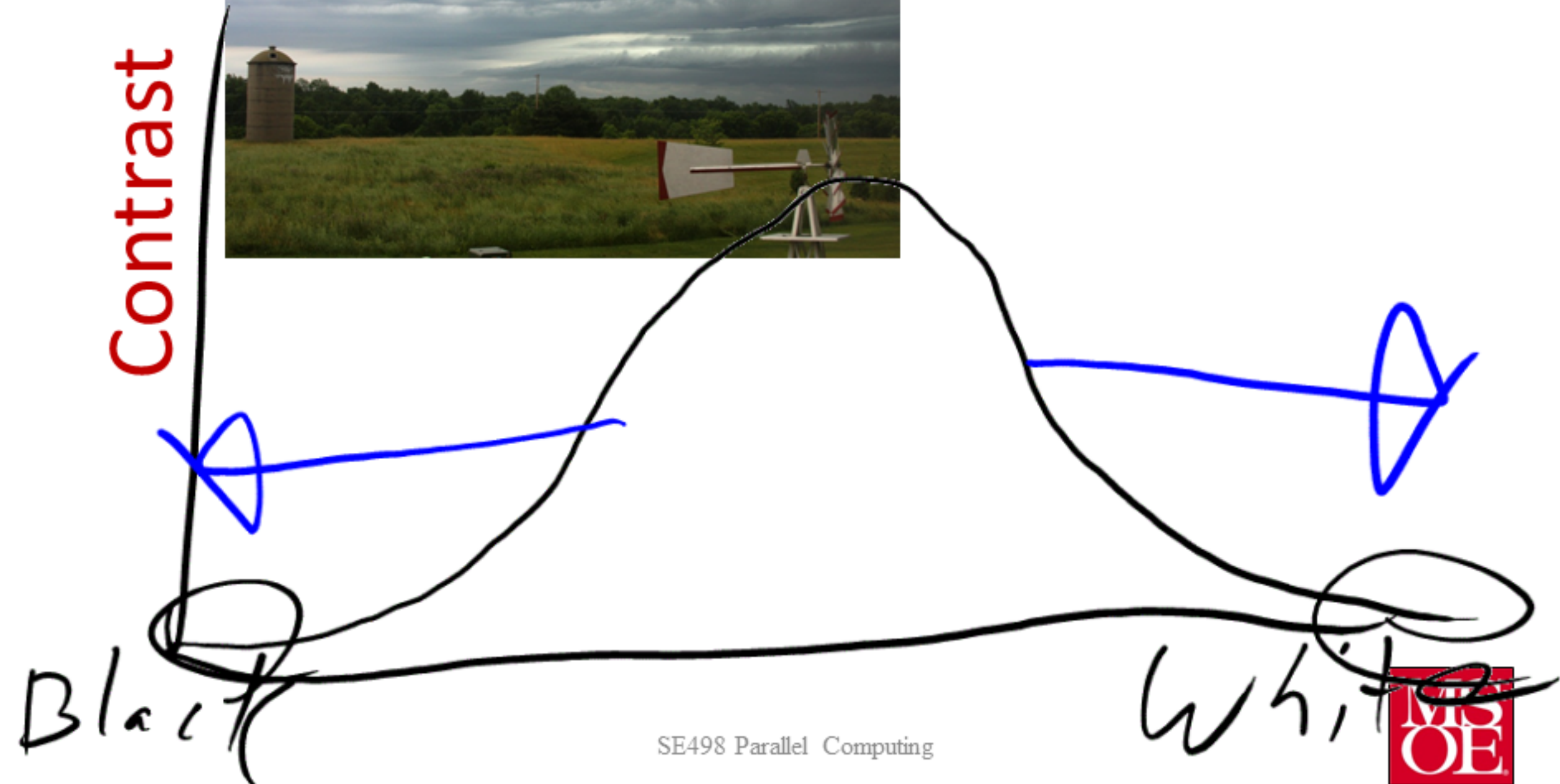*Conversion equations*

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Why HSI?

Lets look at some code.

- Application 1
  - Read an image
  - Convert the image to grayscale
  - Write the image back out to the filesystem.

- The difference between the dark and light segments of an image.
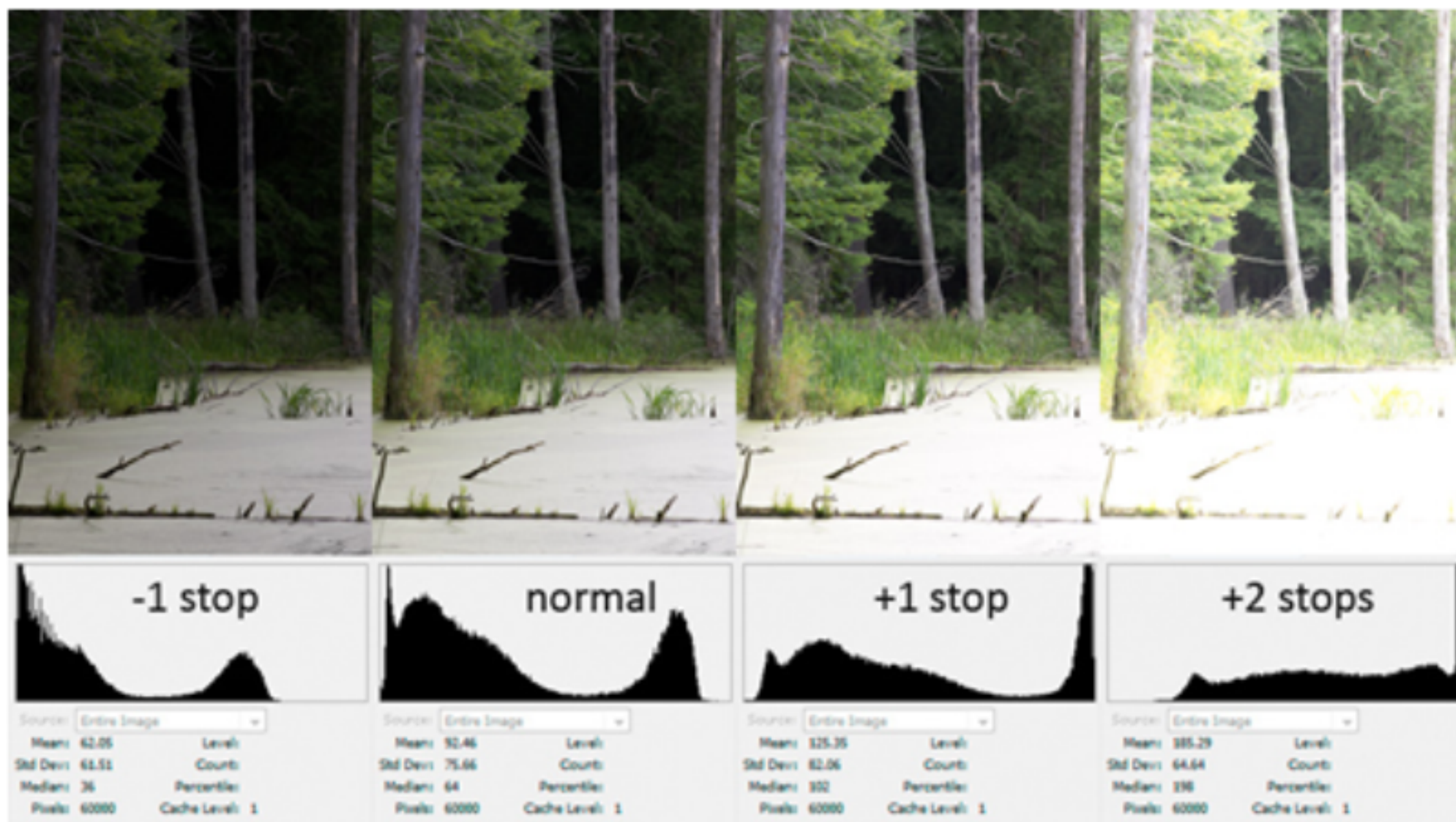
Contrast

Black

White

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Lets adjust the contract of an image.

- A histogram provides a profile of the intensity of an image

How can we calculate a histogram?

MPI Derrived datatype

- int MPI_Type_create_struct(int count, int array_of_blocklengths[],   MPI_Aint array_of_displacements[], MPI_Datatype array_of_types[],   MPI_Datatype *newtype)

- countNumber of blocks (integer) -- also number of entries in
  arrays *array_of_types, array_of_displacements*, and *array_of_blocklengths*.array_of_blocklengthsNumber of elements in each block (array of integers).array_of_displacementsByte displacement of each block (array of integers).array_of_typesType of elements in each block (array of handles to data-type objects).

Lets write an MPI program to calculate a histogram of an image.

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