

SSP 100 - 10

How Computers See

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Today's Topics

- Questions? / Comments?
- More about the size of a channel in an image
- PPM image file format
- Edge detection and its uses

Review

- Can anyone remind us of how a digital image is stored?
- Color image vs. grayscale image

RGB

- Often the size of each of the R, G and B color channels is 1 byte which has a range of 0-255.
- How many different colors can be made if each channel has 1 byte of space?
- $256 * 256 * 256 = 16,777,216$
- One of 16,777,216 different colors can be specified when 1 byte per color channel is used to store the color.

Byte

- A byte is 8 bits
- A bit holds one value (a 0 or a 1)
- Let me show you a little about binary numbers on the board to explain why the range of one byte is 0..255 (one of 256 values).

Grayscale

- Grayscale images hold 1 number per pixel.
- Each pixel is usually 1 byte.
- So, one of 256 different brightness values can be stored per pixel.
- 0 = black
- 255 = white
- All numbers in between are varying levels of gray



Grayscale



- An original color image
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Grayscale



- Grayscale using the formula $0.299 \cdot R + 0.587 \cdot G + 0.114 \cdot B$

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True black and white (monochrome)

- In layman's terms a grayscale image is often described as “black and white”. This is not accurate.
- How much space would one need per pixel to store a true black and white image?

True black and white (monochrome)

- In layman's terms a grayscale image is often described as “black and white”. This is not accurate.
- How much space would one need per pixel to store a true black and white image?
- 1 bit (0=black, 1=white)
- How might one convert a grayscale image to true black and white?

Let's look at ppm image file format

- <https://netpbm.sourceforge.net/doc/ppm.html>
- Let me introduce this because we can represent an image as a plain text file.
- This should drive home the idea that each pixel is made up of 3 values R,G,and B.

Convolution

- Because the digital images are numeric we can do computation on them.
- Let me introduce an operation called convolution of a filter with a grayscale image.
- Technically I'll introduce the cross-correlation operation which is similar to convolution.

Demo programs

- Let me show you some demos of how prewitt filters work (region_edge_in_action.py).
- Also Canny Edge Detection which includes
 - first blurring the image to remove unwanted small details
 - edge detection
 - edge thinning and
 - edge following
 - to get 1 pixel thick edges that are connected into lines

Uses of edge detection

- Defect detection for manufacturing inspection
- Finding boundaries
 - of tumors in medical images
 - of lane lines for robot navigation and self driving
 - of features in satellite or drone imagery
 - and many others