

How to Program with Images

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What is an image?

- Images are fields of colored dots
- Each dot is called a pixel = picture cell
- Standard test image with detail, shading, texture, sharp & blurry regions:

Lena Soderberg '72
(controversy!)

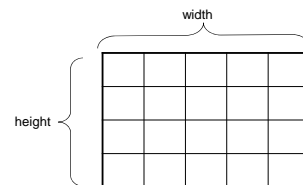


Color Models

- Images can be gray scale, color, or color with an alpha (transparency) channel
- Most common color representation is RGB (Red, Green, Blue). This is the representation used to put pixels on the screen
- Other models include CMYK (used for print) and YUV (often used for input from cameras, compression, and transmission)

What is an image? (2)

- Images are 2 dimensional arrays of data, with an associated width, height, and color depth.
- Images typically use one byte per color channel per pixel.
- Gray images have 1 color channel. RGB images have 3 color channels. RGBA images have 4 color channels.

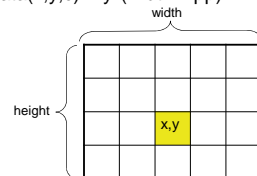


How do I get at the data?

- Some image handling APIs have nice interfaces, but speed can be a problem.
- You will probably have to handle the bytes of data directly at some point

How do I get at the data?

- X = desired row
- Y = desired column
- C = color channel (red, green, blue, ...).
- Bpp = Bytes per pixel (color channels)
- Image data is normally stored in row major order
- Note that there may be multiple values associated with each x,y pixel
- $\text{Data}(x,y,c) = y * (\text{width} * \text{Bpp}) + x * \text{Bpp} + c$



Color to Gray Scale Conversion

- Many computer vision and image processing algorithms are defined for gray scale images
- Converting from color to gray scale is a very common operation

Color Conversion



- Quick and dirty conversion: Grab the Green Channel
- Average R, G, B: $(R+G+B)/3$
- $\text{Max}(R, G, B)$
- Weigh them: $0.3*R + 0.6*G + 0.1*B$

Tools of the Trade

- OpenCV is a widely used, open source computer vision library maintained by Intel
- Provides libraries for image I/O, movie I/O and camera capture
- Industrial strength computer vision and image processing implementations
- Quick and dirty GUI toolkit

Tools of the Trade

- Irfanview is a freely available image viewer and possibly one of the most useful programs ever.

Common Gotcha's

- Sometimes the mapping from a weird looking image to the actual error is not obvious

Common Gotcha's Color Order

- RGB vs. BGR

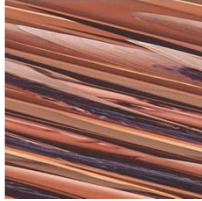


Common Gotcha's Wrong Width

- Incorrect width can result in an image with strong diagonal structure

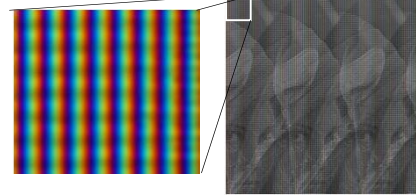
Actual width: 512

This image width:
508



Common Gotcha's Wrong Color Depth

- Mismatched color depth can result in an image with a rainbow effect



Common Gotcha's Windows line endings

- On Windows, it is critically important to open image files in binary mode.
- Otherwise, windows helpfully strips out any bytes with value 'r' (20).

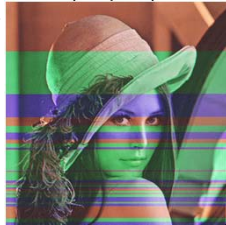


Image File Formats

- PPM / PGM is the simplest file format ever, but not supported by Photoshop or MS Image Viewer. Uncompressed.
- BMP: Microsoft's uncompressed image format
- GIF: Images are compressed using run-length encoding, and reducing the number of colors used. Licensed, not open
- JPEG: Images are compressed by throwing away high frequency information

Go to the CS 585 Lab this week for hands on experience with images!