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
- Data(x,y,c) = y*(width*Bpp) + x*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: \( \frac{R+G+B}{3} \)
- Max(R, G, B)
- Weigh them: \( 0.3R + 0.6G + 0.1B \)

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

- 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!