

# How to Program with Images

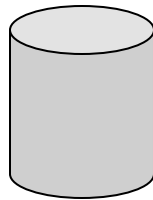
## CS585: Session 1

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# Motivation

- Handling image data is the most basic task in computer vision and image processing
- Images are everywhere! Sources include files, live cameras, and movies



# What is an image?

- Images are fields of colored dots
- Each dot in a picture is called a pixel (picture element)

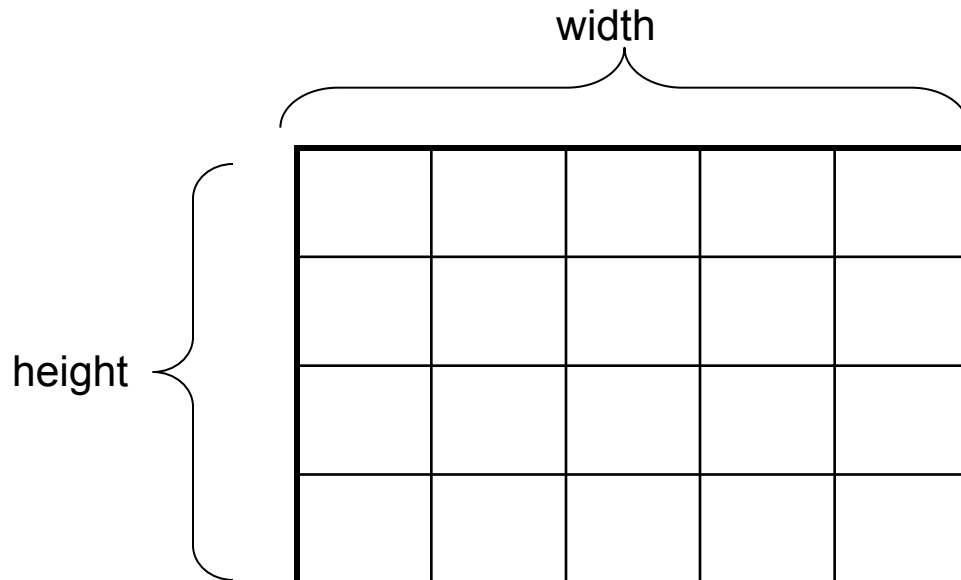


# Color Models

- 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), HSV (used by graphic artists)

# 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.

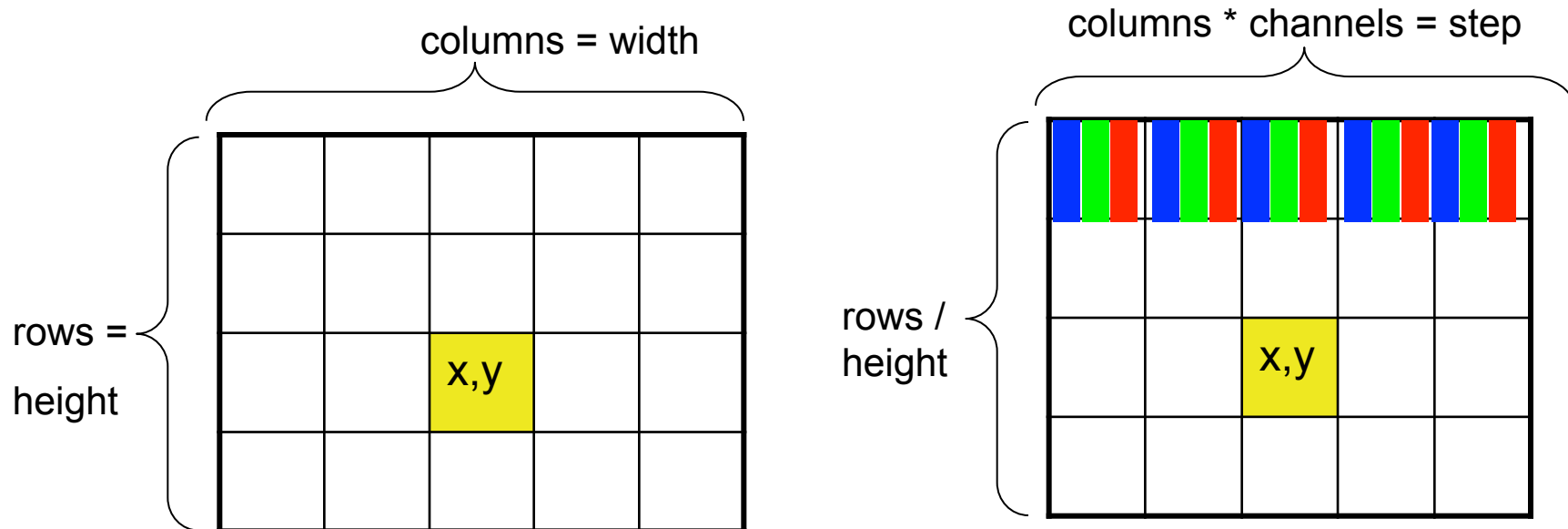


# How do I get at the data?

- Some image handling APIs have nice interfaces, but speed can be a problem.
- You need to learn how to compute indexes into images and handle the raw data.

# How do I get at the data?

- $X$  = desired row
- $Y$  = desired column
- $C$  = color channel (red, green, blue, ...).
- Channels = Bytes per pixel (color channels)
- Image data is normally stored in row major order
- $\text{Data}(x,y,c) = y * (\text{width} * \text{Channels}) + x * \text{Channels} + c$



# Color 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

- Human studies have given us human sensitivities to the various colors.



# Tools of the Trade

- OpenCV is a widely used, open source computer vision library
- 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: 960

This image width: 958



# Common Gotcha's

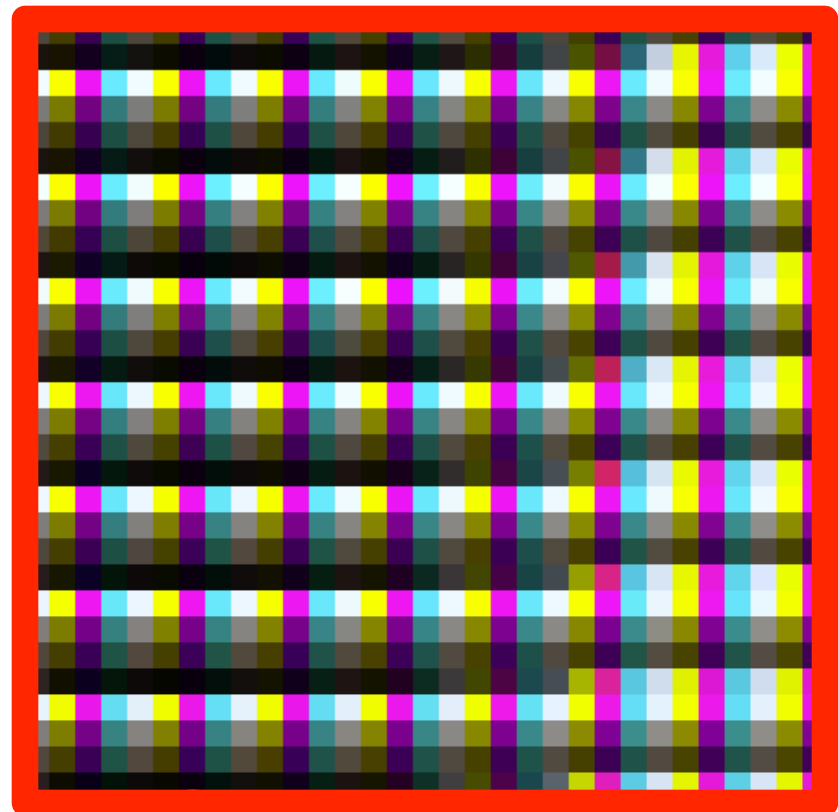
## Transposed Width/Height



# Common Gotcha's

## Wrong Color Depth

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

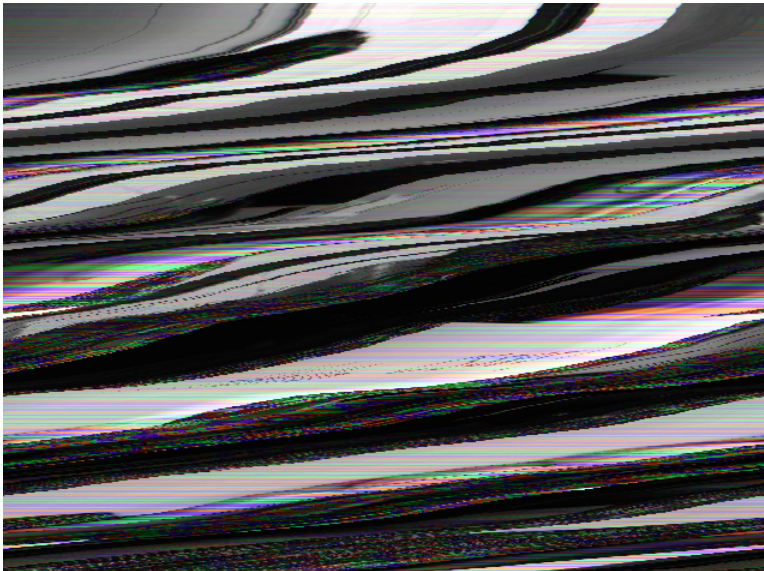




# Common Gotcha's

## 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

- PNG : **Use this**. Non-lossy compression, widely supported.
- JPG: **Don't use this** (for Computer Vision). Images are compressed by throwing away high frequency information.
- 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

Now, you're ready!