CIS 330:

Unix and C++

Lecture 9:
Images

Background on Images

- Definitions:
  - Image: 2D array of pixels
  - Pixel: A minute area of illumination on a display screen, one of many from which an image is composed.
- Pixels are made up of three colors: Red, Green, Blue (RGB)
- Amount of each color scored from 0 to 1
  - 100% Red + 100% Green + 0% Blue = Yellow
  - 100% Red + 0% Green + 100 %Blue = Purple
  - 0% Red + 100% Green + 100% Blue = Cyan
  - 100% Red + 100% Blue + 100% Green = White

Background on Images

- Colors are 0->1, but how much resolution is needed? How many bits should you use to represent the color?
  - Can your eye tell the difference between 8 bits and 32 bits?
  - $\rightarrow$ No. Human eye can distinguish ~10M colors.
  - 8bits * 3 colors = 24 bits = ~16M colors.
- Red = (255,0,0)
- Green = (0,255,0)
- Blue = (0,0,255)

How to organize a struct for an Image (i.e., 3D arrays)

- 3D array: width * height * 3 color channels

- Color:
  - Choice 1: RGB struct
  - Choice 2: just 3 unsigned chars

- Pixels:
  - Choice 1: pointer per row
  - Choice 2: just index it

Many image file formats

- PNG
- GIF
- TIFF
- JPEG
- PNM

Tradeoffs

- Most image formats are hard to read and write
  - So people use libraries to encapsulate reading and writing
  - These libraries are problematic for this class
    - Some will strike out with installing these
    - Different for different platforms
   - Differences in storing them may lead to problems later

What is PNM?

- PNM is part of the Netpbm library
  - http://netpbm.sourceforge.net/doc//pnm.html
- Key advantage: very easy to write and read
- Key disadvantage: not supported by many tools
  - However: package that can convert PNM to PNG, JPEG, etc., is easy to work with.

PNM Format

- There are actually many
  - We will always use "P6"

```
C02LN00GFD58:Proj3A hank$ head -n 4 3A_input.pnm
P6
1786 1344
255
```
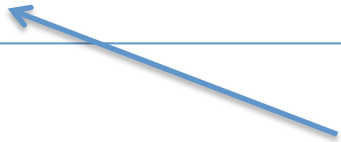
Binary starts here

sscanf

- like printf, but it parses from a string

  sscanf(str, "%s\n%d %d\n%d\n", magicNum, &width, &height, &maxval);

  assuming str has been read in previously as:

  str="P6\n1000 1000\n255\n";

  sscanf would give:

  magicNum = "P6", width = 1000,

  height = 1000, maxval = 255

Last year

- Folks with Linux were very happy
  - Supported by default
- Folks with Mac:
  - Some uploaded their files to websites and inspected them there
  - Some installed programs to convert

- I recommend you do not depend on a website!

Project 3A

- Prompt posted Sunday night, April 26th

- Due on Wednesday May 6th

- Tasks:
  - Struct to contain image
  - Read image from file (simplified format)
  - Write image to file (simplified format)
  - Function to modify image
  - Program that puts it all together

We will be modifying this code throughout the quarter…
(expect you will have to retrofit what you are writing now)