UNIX, C, AND DATA STRUCTURES

Lecture 11: 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?
  - → No. Human eye can distinguish ~10M colors.
  - 8 bits * 3 colors = 24 bits = ~16M colors.
  - 1 byte ↔ unsigned char in C ↔ 0 to 255

- 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
- 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

```c
sscanf(str, "\%s\n\%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
```
Project 2G

• Prompt posted today, Oct 27th
• Due on Saturday November 3rd
• Tasks:
  – Struct to contain image
  – Read image from file (simplified format)
  – Write image to file (simplified format)
  – 2 functions to modify image