



# COLORIZING GRAYSCALE IMAGES

Jason R.

# Project Overview



Project Background



Project Status



Challenges



Education

# PROJECT BACKGROUND



# Why?

- Receive grayscale tiles as 8-bit single channel grayscale images
- Useful to computers
- Need to be colorized as "heatmaps" for useful human observation
- Focus on stronger signals



# ImageMagick

- Image Processing Software
- Direct Pixel Access and Manipulation
- Magick++ API – Object-Oriented C++ API

File Edit View Search Terminal Help

~]\$ magick identify -verbose /home/Downloads/tiles/large\_1.jpeg

```
image:
Filename: /home/Downloads/tiles/large_1.jpeg
Format: JPEG (Joint Photographic Experts Group JFIF format)
Mime type: image/jpeg
Class: PseudoClass
Geometry: 512x512+0+0
Units: Undefined
Colorspace: Gray
Type: Grayscale
Base type: Undefined
Endianness: Undefined
Depth: 8-bit
Channel depth:
  Gray: 8-bit
Channel statistics:
  Pixels: 262144
  Gray:
    min: 34 (0.133333)
    max: 184 (0.721569)
    mean: 61.8672 (0.242616)
    median: 58 (0.227451)
    standard deviation: 14.1521 (0.0554983)
    kurtosis: 13.2856
    skewness: 2.6749
    entropy: 0.796276
Colors: 117
Histogram:
22: (34,34,34) #222222 gray(34)
20: (35,35,35) #232323 gray(35)
78: (36,36,36) #242424 gray(36)
302: (37,37,37) #252525 gray(37)
221: (38,38,38) #262626 gray(38)
433: (39,39,39) #272727 gray(39)
428: (40,40,40) #282828 gray(40)
805: (41,41,41) #292929 gray(41)
1142: (42,42,42) #2A2A2A gray(42)
1817: (43,43,43) #2B2B2B gray(43)
2403: (44,44,44) #2C2C2C gray(44)
3343: (45,45,45) #2D2D2D gray(45)
3687: (46,46,46) #2E2E2E gray(46)
5068: (47,47,47) #2F2F2F gray(47)
4756: (48,48,48) #303030 gray(48)
6342: (49,49,49) #313131 gray(49)
6594: (50,50,50) #323232 gray(50)
8264: (51,51,51) #333333 gray(51)
8455: (52,52,52) #343434 gray(52)
9125: (53,53,53) #353535 gray(53)
10715: (54,54,54) #363636 gray(54)
11818: (55,55,55) #373737 gray(55)
11809: (56,56,56) #383838 gray(56)
12209: (57,57,57) #393939 gray(57)
13071: (58,58,58) #3A3A3A gray(58)
12311: (59,59,59) #3B3B3B gray(59)
10946: (60,60,60) #3C3C3C gray(60)
10620: (61,61,61) #3D3D3D gray(61)
```



# The Project

- Generate colored "heatmaps" of grayscale tiles
- Convert type grayscale images to sRGB
  - 8-bit channel -> 24-bit channel

# PROJECT STATUS



```

File Edit View Search Terminal Help
~]$ magick identify -verbose /home/~/Downloads/tiles/Colorized_Images/Colorized-large_1.jp
Image:
Filename: /home/~/Downloads/tiles/Colorized_Images/Colorized-large_1.jpeg
Format: JPEG (Joint Photographic Experts Group JFIF format)
Mime type: image/jpeg
Class: DirectClass
Geometry: 512x512+0+0
Units: Undefined
Colorspace: sRGB
Type: TrueColor
Base type: Undefined
Endianness: Undefined
Depth: 8-bit
Channel depth:
  Red: 8-bit
  Green: 8-bit
  Blue: 8-bit
Channel statistics:
  Pixels: 262144
  Red:
    min: 0 (0)
    max: 71 (0.278431)
    mean: 0.293484 (0.00115092)
    median: 0 (0)
    standard deviation: 3.13044 (0.0122762)
    kurtosis: 231.785
    skewness: 14.2577
    entropy: 0.0325065
  Green:
    min: 0 (0)
    max: 253 (0.992157)
    mean: 1.1363 (0.00445608)
    median: 0 (0)
    standard deviation: 14.9976 (0.0588141)
    kurtosis: 240.227
    skewness: 15.4226
    entropy: 0.0379558
  Blue:
    min: 0 (0)
    max: 104 (0.407843)
    mean: 0.498829 (0.00195619)
    median: 0 (0)
    standard deviation: 4.85894 (0.0190547)
    kurtosis: 228.19
    skewness: 13.924
    entropy: 0.0375375
Image statistics:
Overall:
  min: 0 (0)
  max: 253 (0.992157)
  mean: 0.642871 (0.00252106)
  median: 0 (0)
  standard deviation: 7.66232 (0.0300483)
  kurtosis: 559.841
  skewness: 22.6306
  entropy: 0.0359999

```

# Current Status

- Colorize single image or directory of images
- 670 available colors
- Build via Make
- Customize contrast values and CLUT colors



# PROGRAM STRUCTURE // Classes (basic summary) & Screenshots

- Color Look Up Table
  - Scrnshst of prototype\_clut
  - Scrnshot of final clut
- Utilize boost program\_options



# BASIC PROGRAM STRUCTURE // Classes (basic summary) & Screenshots

- Screenshot of tiles colorized with default options
- Screenshot of tile colorized with default and contrast (56)
- Screenshot of tiles colorized with custom colors ( navy , green, turquoise)
- Screenshot of tiles colorized with custom colors and contrast (75 or 100)

# Future Development



CD/CI Integration &  
Tests



Appropriate  
Documentation



Intermediary  
MakeFiles for  
compilation



Overall Project  
Completion: ~85%  
completion



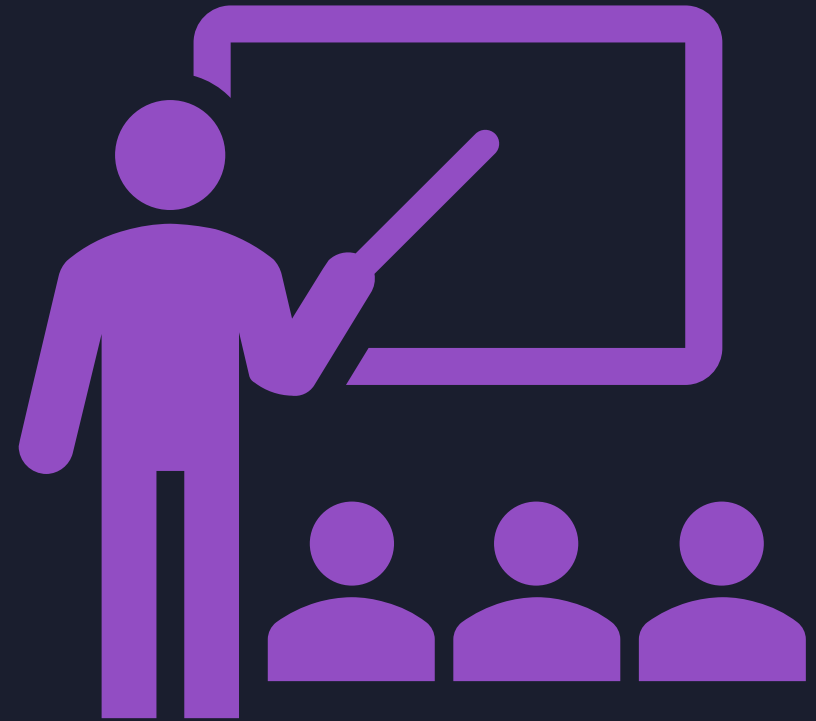
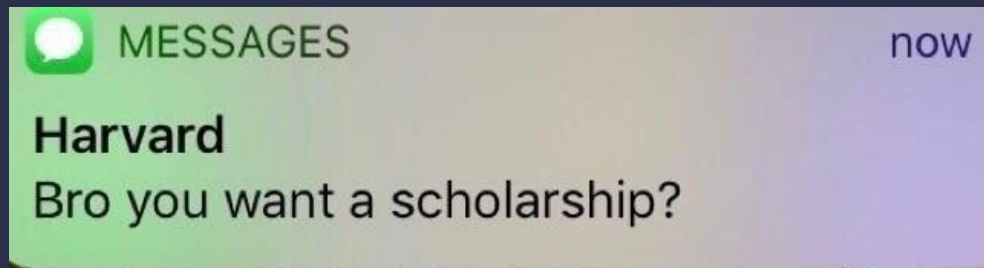
# CHALLENGES



# Challenges

- Comprehending my task & given resources
  - C++ Tutorials
  - Searching APIs for useful functions
  - Initial Algorithm -> Object-Oriented Program
- Starting completely from scratch
- Pivot to MagickWand
  - interface between C & IM image processing libraries

# WHAT I'VE LEARNED



# A Summer of Learning

- C++ & Object-Oriented Design
- Linux & Bash
- Code Design/Debugging/Review
- Asking for Help

NEVER HAVE I FELT SO  
CLOSE TO ANOTHER SOUL  
AND YET SO HELPLESSLY ALONE  
AS WHEN I GOOGLE AN ERROR  
AND THERE'S ONE RESULT  
A THREAD BY SOMEONE  
WITH THE SAME PROBLEM  
AND NO ANSWER  
LAST POSTED TO IN 2003

WHO WERE YOU,  
DENVERCODER9?

WHAT DID YOU SEE?!





ARE YOU READY?

[DEMO]





THANK YOU!