

CS 101

Spring 2016

Program Assignment # 5

Algorithm Due : Sunday, March 20, 2016

Program Due : Sunday, March 27, 2016

Image Filters

Many social media sites allow you to apply filters to your images for neat effects. We're going to read a text image format and apply 1 of 2 image filters that the user chooses and then save the image out. Our two image filters will be a conversion to grayscale and one that converts the color to a more 70's vintage look.

Original



Grayscale



Vintage



PPM Files

Portable PixMap format or PPM is a simple image file format. There are a few variants of the PPM format, but we will be concentrating on one particular specification of the text file versions. Since it's just a normal text file, we can open, read and write the image files just like they were any normal text document. This makes it very convenient since we can use all the Python file handling techniques we've learned this semester. We have included ***ppmReader.html*** to view the ppm files that have been supplied. Using the ppmreader.html you can load a text .ppm file to view it in your browser. You may also want to use an image editor like gimp to view the images (<http://www.gimp.org>). You will also want to examine the files in a text editor.

PPM Format (Ocean.ppm)

Line #	Example Data	Description
1	P3	PPM Header information. P followed by a number.

		We'll be using the P3 format.
2	3072 2304	Size of the image in pixels. This 3072 wide and 2304 pixels tall.
3	255	Color Depth of the Image. Each Red, Green, Blue component will be 0-255 in value. This is always 255 in our examples.
4	143	Red Component of the first pixel.
5	211	Green component of the first pixel
6	255	Blue Component of the first pixel
7	144	Red component of the second pixel
...
21233665	80	Red component of last pixel
21233666	112	Green component of last pixel
21233667	135	Blue Component for the last pixel.

The PPM format is very flexible. In our incarnation each color component is on a separate line. We also will not have any comments in the header. **If you save an ASCII ppm file from gimp you will have to edit the resulting text file and remove the comment from the header to use the ppmreader.html file.**

Convert to Grayscale

A grayscale image removes all the color from an image. Instead it is replaced with an intensity value. Since we're using the range 0-255 for our color range, the grayscale will be 0 for black, and 255 for white. For each red, green, blue value, we'll find the corresponding grayscale color and replace each of them with the grayscale intensity. We could average out the red, green and blue for our new grayscale color value, but the human eye perceives red and green as brighter than blue. So any red, green intensities would be under represented, while blue would be over represented. Instead we'll weight each color value

$$grayscale = 0.299 * red + 0.587 * green + 0.114 * blue$$

The resulting grayscale value will need to be an int from 0-255. For each pixel you simply compute the value from its red, green and blue components. That new value is the red, green and blue value for that pixel.

If red, green blue values are 250, 180, and 70 then we compute grayscale as...

$$\text{grayscale} = 0.299 * 250 + 0.587 * 180 + 0.114 * 70 = 188.39 = 188$$

	Original Image Values	New Image Value
...		
pixel 3,192 red value	250	188
pixel 3,192 green value	180	188
pixel 3,192 blue value	70	188
pixel 3,193 red value	90	114
pixel 3,193 green value	110	114
pixel 3,193 blue value	200	114
...		

Convert to Vintage

Old photographs taken on film will yellow and darken over time. So our Vintage filter has to do both. (we'll actually just change one of the color values.). Increasing the red and green components of a color will make it look more yellow, however, this will also make our image brighter. We want it to be more yellow but darker as well. If we remove some of the blue from the color it will make our picture more yellow and darker at the same time. What we'll do is half the blue component value. If it was 200, then we'll take it to 100.

	Original Image Values	New Image Value
...		
pixel 3,192 red value	250	250
pixel 3,192 green value	180	180
pixel 3,192 blue value	70	35
pixel 3,193 red value	90	90
pixel 3,193 green value	110	110
pixel 3,193 blue value	200	100
...		

Images

You will be provided several images that you can experiment with. Since the files are extremely large and can be confusing we'll also give you a small 2x2 image which will have 4 total pixels. With 3 color value for each pixel there will be 12 lines of color information and 3 lines for the header. This should make it easier to debug and test at first. Use this sample file to figure out the new values by hand. This will make it easier to validate your program.

Line #'s	small.ppm	small_grey.ppm	small_vintage.ppm
1	P3	P3	P3
2	2 2	2 2	2 2
3	255	255	255
4	255	76	255
5	0	76	0
6	0	76	0
7	0	149	0
8	255	149	255
9	0	149	0
10	0	29	0
11	0	29	0
12	255	29	127
13	255	255	255
14	255	255	255
15	255	255	127

Line 4, 5, and 6 are the red, green and blue for pixel 1. The gray value for 255, 0, 0 is 76. Lines 13, 14 and 15 are the red, green and blue for pixel # 4. Since we leave the red, and green, but half the blue, the blue gets changed to 127.

Requirements

- Display a menu to the user. The user can choose to 1. Convert an image to grayscale, 2. Convert an image to Vintage, or Q Quit.
- Ask the user for a valid file. If the file does not exist the user should be warned and prompted again.
- The PPM files that are loaded should be validated to make sure the first line is P3, signifying that is a PPM file, and the color depth is 255..
- Ask for an output image to save our changes to. If the file cannot be created the user should be warned and prompted again..
- Once you have the input file and the output make the proper conversion to the file. You can check your results with the ppmReader.html file.

Definitions

Pixel - any one of the very small dots that together form the picture on a television screen, computer monitor, etc. ¹

Example

```
>>> ===== RESTART =====  
>>>
```

```
Image Filters
```

- 1. Convert Image to GrayScale
- 2. Convert Image to Vintage
- Q. Quit

```
==> e
```

```
You must enter a valid choice. (1,2,Q)
```

```
Image Filters
```

- 1. Convert Image to GrayScale
- 2. Convert Image to Vintage
- Q. Quit

```
==> 1
```

```
Enter a valid filename to convert. ==> notfound
```

```
The file you specified does not exist. Please enter a valid filename
```

```
Enter a valid filename to convert. ==> badheader1.ppm
```

```
The files first line should be P3
```

```
Enter a valid filename to convert. ==> badheader2.ppm
```

```
The color depth must be 255
```

```
Enter a valid filename to convert. ==> park.ppm
```

```
What is the name of the file you want to save to? ==> park_gray.ppm
```

```
Your file has been saved.
```

```
Image Filters
```

- 1. Convert Image to GrayScale
- 2. Convert Image to Vintage

Q. Quit

```
==> 2
```

```
Enter a valid filename to convert. ==> park.ppm
```

```
What is the name of the file you want to save to? ==> park_vintage.ppm
```

```
Your file has been saved.
```

Image Filters

```
1. Convert Image to GrayScale
```

```
2. Convert Image to Vintage
```

Q. Quit

```
==> q
```

```
>>>
```

Extra Credit (5 Points)

The image directories also contain .jpg files. The PPM files supplied were text image files and can be opened and worked with as a text file. Jpeg files are binary files. The PIL library allows you to open other image types like JPegs, as well as create new images. You will have to install the PIL module to get it on your personal computer, however it is installed in the labs in FH. Directions for this are not included.

- Add a new menu item to convert a jpg to grayscale and one to convert a jpg to Vintage.
- Load the image with the pil module and create a new jpg with the proper conversion.
- The PIL library is loaded in the Computer Science lab. If you want the PIL library on your own computer you will have to install the PIL module for your version of Python.

References

1. "Pixel." *Merriam-Webster*. Merriam-Webster, n.d. Web. 15 July 2014.

<<http://www.merriam-webster.com/dictionary/pixel>>.

2. Pillow documentation <https://pillow.readthedocs.org/en/latest/>