

CSC104 Assignment #1

Due: February 8th, 2011

Q1. Encoding concepts

A colour in a picture is made up of Red, Green and Blue components each of which use 8 bits (1 byte)

(2)1a. How many possible values of Red are there in a picture? Is it the same for green or blue? How many possible colours does this make?

(2)1b. If I have a picture that is 400 pixels across and 600 pixels down, how many bytes does it take to represent this image as a Python picture object? To be clear I mean no compression technologies are used (ex. not a JPEG, not zipped, etc.)

Q2. Luminance

(1)2a. In the RGB representation (0,0,0) is black and (255,255,255) is white.

Which of the following colours is darkest: ((5,5,5), (200,200,200) OR (100,100,100))?

Which of the previous 3 colours is lightest: ((5,5,5), (200,200,200) OR (100,100,100))?

(1)2b. In the previous question it was easier to characterize lightness and darkness than it is in the general case. This is because we used RGB values that had the same ratio (R:G:B was 1:1:1). It is possible to compare colours in general on this basis. The term we use for this is luminance or intensity. The formula for luminance is $(\text{red} + \text{green} + \text{blue})/3$. The higher a luminance is, the 'lighter' the colour is. Which of the following colours has the highest luminance: (5,22,84), (100,2,209), (50,20,40)? Which has the least luminance: (5,22,84), (100,2,209), (50,20,40)?

(4)2c. Write a Python function which takes a pixel as input and returns its luminance. See the instructions on the opposite side of this page for filenames.

Q3. Grayscale by Luminance and grayscale by Perception Weights

(5)3a. As mentioned above (0,0,0) and (255,255,255) represent black and white. In fact all components that have equal weights of R,G and B represent the various grays. Write a Python program that takes a pixel and returns a shade of gray using the luminance of that pixel.

(5)3b. In practice, humans don't perceive red, blue and green as equally dark, so using equal weights results in a grayscale image that would look rather strange. Instead of using 1/3rd of each colour in practice it is useful to use Red * 0.299, green * 0.587 and Blue * 0.114 to make up the new colour. Note that these values add up to 1 (just Like $1/3 + 1/3 + 1/3 = 1$ from the old formula). This is important because if a colour is already gray we don't want to change it to a different gray. Write a Python Program that takes a pixel and returns a shade of gray by adding up the weighted components listed here.

Q4. Negatives

(5)4. The negative of a pixel is given by taking 255 minus the current value of the colour as the new value for the colour for each of the colours (red,green,blue). Write a program that computes the negative of an image.

Q5. Using loops to apply pixel manipulations over entire pictures. (OVER)

(5)5a.i. Write a python program which uses the file picker to select a picture file, then converts that image to grayscale using your function from 3A.

(5)5a.ii. Write a python program which uses the file picker to select a picture file, then converts that image to grayscale using your function from 3B.

(5)5.b.i Write a python program which uses darkens a picture by 25%. You will have to figure out what to do to each pixel as well as loop over all pixels.

(5)5.b.ii. Write a python program which uses your Negative function to take the negative of an entire picture.

(15)5.b.iii. Write a python program which uses B.ii to take the negative of a picture, uses B.i to make the picture darker by 25%, and then uses B.ii to take the negative again?**5.b.iv.** What happened to the picture? Assume you have a pixel in your picture with redValue 100. What is the redValue after taking the negative? What is the redValue after darkening by 25%? What is the redValue after taking the negative? Why did the change that happened to the picture happen? If you don't want to do the math by hand on this problem you are welcome to use Python to assist you.

Question 6: Cropping a Photo

(20)6. Write a general crop function that takes a source picture, the start X value, then start Y value, the end X value, and the end Y value. Create and return the new picture and copy just the specified area into the new picture.

Question 7: Scaling a Photo

(20)7. Write a general scaleUp function that takes in a picture and creates and returns a new picture twice as big using makeEmptyPicture(width,height).

Handing in your assignment

Instructions on how to hand in your assignment will be posted on the course webpage. You will be required to hand in specific files. You may copy and paste material from one file into another.

1. answers (a plain text file created using nedit that you will use to answer the non-programming questions),.
2. computeLuminance.py (a program for 2c)
3. singlePixelGrayscaleByLuminance.py (a program for 3a)
4. singlePixelGrayscaleByOptics.py (a program for 3b)
5. computeNegative.py (a program for 4)
6. pictureGrayscaleByLuminance.py (5ai)
7. pictureGrayscaleByOptics.py (5aai)
8. negativesAndDarkening.py(5b)
9. crop.py(Q6)
10. scaleUp.py (Q7)

Total Marks: 100

Percentage of Course Grade: 15%