

CS 675 – Computer Vision – Spring 2022
Instructor: Marc Pomplun

Assignment #1

Sample Solutions

Question 1: Resizing Grayscale Images

See file `assignment1_solutions.py` for sample solutions. You can also use the attached script file `assignment1_test_script.py` to run the same tests for Questions 1 and 2 that I used for testing your code (but I also read your code to look for mistakes that could easily be fixed).

(a) Maximum score: 25 points

(b) Maximum score: 20 points (bonus)

Question 2: Floyd-Steinberg Dithering

(a) Maximum score: 25 points

(b) Maximum score: 25 points

(c) Maximum score: 20 points (bonus)

Question 3: Color Space Conversions

(a) Given a range of the R, G, and B components from 0 to 255, the color defined by $R = 200$, $G = 25$, and $B = 180$ is some shade of purple. Convert this color into the HSI color space using the method we discussed in class and showing each step of your computation.

First, we normalize the RGB values:

$$R_n = 200/255 = 0.784,$$

$$G_n = 25/255 = 0.098,$$

$$B_n = 180/255 = 0.706$$

Then we calculate the normalized intensity: $I_n = 1/3 \cdot (R_n + G_n + B_n) = 0.529$.

The original (non-normalized) intensity would be:

$$I = (200 + 25 + 180)/3 = 135$$

(Either answer is correct.)

Then we use the formula for hue:

$$\begin{aligned}\cos H &= \frac{2R - G - B}{2\sqrt{(R - G)^2 + (R - B)(G - B)}} = \frac{2 \cdot 200 - 25 - 180}{2\sqrt{(200 - 25)^2 + (200 - 180)(25 - 180)}} \\ &= \frac{195}{2\sqrt{30625 - 3100}} = \frac{195}{2\sqrt{27525}} = \frac{195}{331.813} = 0.588\end{aligned}$$

And since $B > G$, we have $H = 360^\circ - \arccos(0.588) = 306^\circ$

$$S = 1 - \frac{3}{R+G+B} \min(R, G, B) = 1 - \frac{3}{200+25+180} \cdot 25 = 1 - 0.185 = 0.815$$

Maximum score: 15 points

- (b) We did not discuss how to convert HSI values back to RGB, but based on the definitions we covered, this should not be too difficult a task: What are the R, G, and B values (again, scaled from 0 to 255) of a color with a hue of 240° , a saturation of 1, and an intensity of 0.2? Show each step of your reasoning and computation.

The hue of 240° tells us that the color is exactly blue, and given the saturation value of 1, it is perfectly saturated, i.e., the other two RGB components, R and G, must be 0. We now just have to determine the B value in such a way that the normalized intensity is 0.2. The normalized intensity is simply the average of the normalized intensities R_n , G_n , and B_n . Since we know that both R_n and G_n are zero, B_n must be 0.6 for the overall normalized intensity to be 0.2. In order to get the B value on the scale from 0 to 255, we have to compute $0.6 \cdot 255 = 153$.

Consequently, the RGB vector of the given color is (0, 0, 153).

Maximum score: 10 points

Total maximum score: 100 points + 40 bonus points

Your grade is based on your total points, including bonus points, with 100 points or more corresponding to a 100% score (A) for this assignment. This means that you need 95 points for an A, 90 for an A-, and so on (see slides from January 25). You cannot get more than 100% on any assignment or exam, but if you sometimes got more points than necessary for a 100% score and are between two grades at the end of the course, it could push you towards the better grade.