CS4363/5363 Computer Vision

Spring 2021

Lab 1

Due Friday, January 29

For this lab you will experiment with array operations applied to image processing in Python. Use the program *lab1.py* as starting point and implement the following:

1 Part I

Write functions to do the following:

1. Read an image from a file and display it on your screen (code is already provided).
2. Display a subsampled version of the image, including only rows, $0, r, 2r, 3r, ...$ and columns $0, c, 2c, 3c, ...$ for integers r and c.
3. Display separately the red, green, and blue channels in image.
4. Display the red, green, and blue color indices of the image. Let R, G, B be the red, green and blue channels of an image; let R_i, G_i, and B_i be the red, green and blue indices, then $R_i = 2R - G - B$, $G_i = 2G - R - B$, $B_i = 2B - R - G$.
5. Display the gray level (intensity) version of the image. Let R, G, B be the red, green and blue channels of an image, let I be the intensity image, then $I = 0.299R + 0.587G + 0.114B$
6. Display the negative of the gray level version of the image.
7. Display the mirrored (left-right) version of the original color image.
8. Display the original color image upside down.
9. Display the vertical edges in the image.
10. Display the horizontal edges in the image.
11. Display the magnitudes of the edges in the image.

2 Part II

Write a function to find the brightest region of size $r \times c$ in an image, where r and c are user-provided integer parameters. The brightest region of size $r \times c$ in an image I is the subarray $I[i : i + r, j : j + c]$ of I that has the highest sum (or, equivalently, mean) for all valid values of i and j. For every valid value of i and j, the mean or average intensity of the region of size $r \times c$ with top-left corner (i, j) is given by: *np.mean(I[i:i+r,j:j+c])*.

1. Find the brightest region of size $r \times c$ in the intensity image and draw a rectangle surrounding it.
2. Find the darkest region of size $r \times c$ in the intensity image and draw a rectangle surrounding it (notice that the darkest region is the same as the brightest region in the negative image).
3. Find the brightest region of size $r \times c$ in the red index image and draw a rectangle surrounding it.
4. Find the brightest region of size $r \times c$ in the green index image and draw a rectangle surrounding it.
5. Find the brightest region of size $r \times c$ in the blue index image and draw a rectangle surrounding it.

2.1 Extra Credit for 4363, mandatory for 5363

Notice that the algorithm for finding the brightest region described above performs a lot of repeated computations. Find a way to speed it up.

3 Submission

Submit a report including (at least) the following items:

1. Problem description
2. Algorithms implemented
3. Experimental results
4. Discussion of results
5. Conclusions
6. Appendix: Source code

4 Appendix - Sample resulting images

Original image

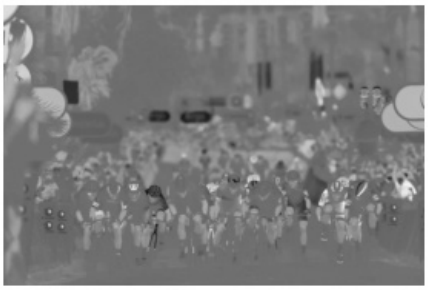
Subsampled image

Red

Green

Blue

Red



Green

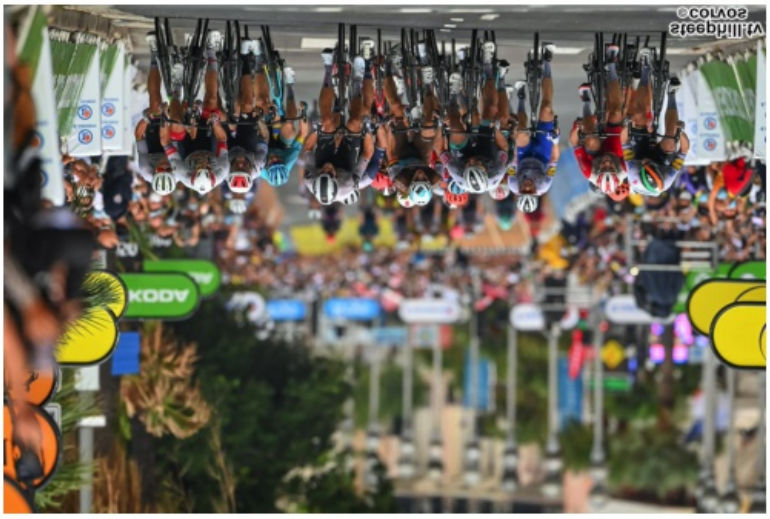
Blue

Gray-level image

Negative gray-level image

Mirrored image

Upside-down image



Vertical edges

Horizontal edges

Edge magnitudes

Brightest regions