CS867: Computer Vision

Instructor: Muhammad Moazam Fraz

November 9, 2020

Assignment 1

Basic Image Analysis Operations

Due Date: November 16th 2020 at 11:55pm

National University of Sciences and Technology

School of Electrical Engineering and Computer Science

Department of Computing

1 Introduction

The assignments in with course will cover a wide range of topics in computer vision and aimed at giving the students hand-on exposure to a abroad range of concepts and applications.

There is rich set of image processing libraries available in Python. During this course, the students will be trained to use them with the help of assignments.

A comprehensive list of Python libraries and packages used for computer vision can be seen at GitHub helper repository created for this course https://github.com/visionatseecs.

Several electronic books are provided in a google drive, the link is shared on LMS. These books can be an excellent resource for the beginners as well as for the experts.

Assignment 1 starts off with an introduction on how to use images in python and numpy. It focuses on understanding and implementing the basic concepts such as image manipulation operation using matrices, convolutions, different kernels and how to design them and edge detection e.t.c. A couple of extra credit questions are also there.

1.1 How to work on Assignment 1?

You are required to create a "*.ipynb" notebook in order to show all the outputs of the asked queries. Also create another "python script" i.e. *.py" where you will be coding helper functions and later use those functions in notebook to show the results only. Plus your code should be well commented and easy to use.

How to Use Jupyter Notebook : A Beginner's Tutorial

1.2 Assignment Submission Instructions

You need to submit the files on GitHub (after creating the repository) AND on LMS as well.

Submission on LMS

After you have completed the assignment, you need to submit the following deliverable on LMS:

1: Assignment-1.pdf. - Export the Assignment.ipynb as a PDF and submit it to LMS. (execute the notebook and print as PDF)

2: Assignment-1.ipynb.

3: *.py - All the python files we ask you to code up must be submitted to LMS.

Place all files in a folder. Rename the folder as "Your FirstName-Your LastName", zip it (like Asad-Ali.zip) and submit it on the link given on LMS.

Submission on Github

Create a Github repository (say CS867 Assignment 1) and upload your jupyter notebook and associated files over there. A Google form will be shared by the TA, where you will submit the URL of your Github repository.

If you are not familiar with using GitHub, some use full links on creating GitHub repositories are given below.

- Getting Started with GitHub
- A Beginner's Guide to Git-How to Start and Create your First Repository.

Please make sure that the code must run without errors, because it may be marked by automated scripts. NO credit will be given if code fails to run properly.

1.3 Collaboration Policy

Study groups are allowed in general, BUT this is an individual assignment and we expect the students to understand and complete their own assignments and to hand in one assignment per student. Moreover, we expect students to not look at implementations online. We take the student Honor Code seriously.

1.4 Teaching Assistant Availability

PhD scholar Mr Syed Nauyan Rasheed will be available on MS Teams to guide and help you regarding the assignment. He may arrange an interactive session with the students on MS Teams.

2 Tasks

A set of images is given with this assignment to perform the following tasks. However, feel free to use your own set of images.

2.1

Load the set of images and display them as Grayscale and rgb images. You are required to show these images "inline" rather than creating a new window for every other image. *(2 points)*

2.2

Implement the function rgbExclusion() in the helper script, in which the input image is decomposed into the three channels: R, G and B and return the image excluding the specified channel. Display the results in notebook. *(3 points)*

2.3

Take at-least 3 images from given set and plot histograms before and after applying histogram equalization. Show these image inline format i.e. grayscale image –> display histogram –> apply histogram equalization–> display the equalized image and its histogram. *(5 points)*

2.4

You are required to implement the convolution operation from scratch. This function which takes an image and a kernel and returns the convolution of them.

Compare the results of your implemented function with the ones available (built-in) in python packages. You are required to convolve images for sharpening and blurring effects. *(5 points)*

2.5

Load a couple of images from the given set.
1. Apply box filter using convolution, and display the resultant image
2. Apply Gaussian filter to the image, with varying sigma values.
3. Add Gausian Noise and Salt and Pepper Noise to them.
4. Apply Gaussian Filter and Median Filters.
5: Display mesh plots for different i) Gaussian filters, ii) First Order Derivative of Gaussian, iii) Laplacian of Gaussian; using different sigma values

You are encouraged to play with the different parameter values.The results should be displayed in three columns i.e Original Image, Corrupted Image and the Filtered Image.
(20 points)

2.6

Load a few images from the given set.
1. Apply Sobel operator, computer gradient magnitude and display the results (original image, gradient images and gradient magnitude image).
2. Apply Laplacian of Gaussian, computer laplacian magnitude and display the results (original image, filtered images and laplacian magnitude image). Try different filter kernel coefficients.
3. Apply Canny Edge Detector and display the results.

You are encouraged to play with the different parameter values *(20 points)*

2.7 Bonus Marks

(5 points) Implement Canny Edge detector from scratch or use built-in function from python packages, and apply it on a real time video/stream.

Hint: You can use ipywebrtc library (in jupyter notebook or you can also open new window for showing output.