

Assignment 1

Deadline for submission:

- 1 week (strict – until Monday 17 November 12:00 PM)
- Late submissions will not be possible!
- Only *complete* submissions in Moodle will be graded (both files submitted)!

Upload in Moodle: 2 files:

- 1 doc/docx or pdf document (code & images & explanations, **in sequential manner**: specify the subsection number, add the code & images & explanations, then continue with the next subsection, add code ... and so on);
- 1 Python file with the entire code – *file_student_name.py*

Important:

Students will present their assignments and answer questions during laboratory_3 and other 2 established intervals, possibly laboratory_4. *The assignments are not graded without a discussion student-professor in Teams!* (all questions regarding the assignments will relate to the files uploaded in Moodle).

General Requirements

Solve all the following exercises in 1 Python file, using Numpy, OpenCV and Matplotlib functions as indicated.

Subsection 1.

Read in PyCharm the background image indicated next to your name in the table. Apply a histogram equalization algorithm studied in Laboratory_1 for this background true-color (RGB) image. The output should also be a true-color image, name it *back_eq.jpg*. The histogram equalization algorithm should modify only the pixel intensities (luminance) and not change the color tone! Use an appropriate color transform.

Analyze the background image histogram and choose the appropriate algorithm. Justify your choice in a short comment, by comparing the initial and final histograms (before and after the use of the histogram equalization technique). Include a figure containing the original and corrected histograms.

Subsection 2.

Crop an area from the center of the background image *back_eq* in Python up to the dimensions of your working image “#_noisy.jpg”, given in the table. Save the crop from the background image as *back_eq_crop.jpg*.



Cropped area of 200x200 pixels

Original background image

Figure 1. **Example** of original background image and a cropped area of 200x200 pixels (here the working image has been considered “7_noisy.jpg”)

Subsection 3.

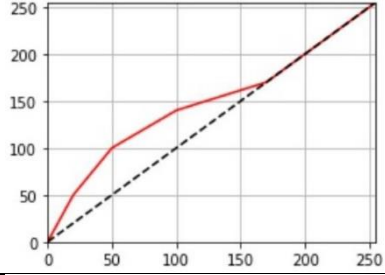
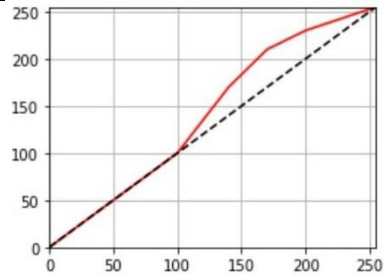
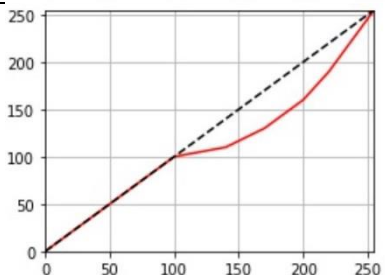
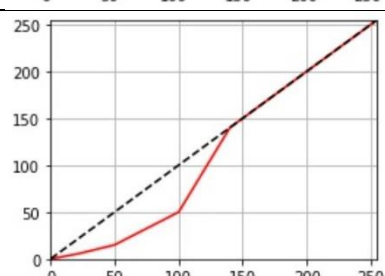
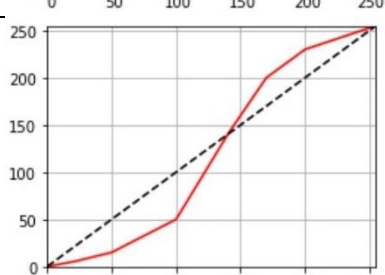
Identify your assigned working image in the table, “#_noisy.jpg”. Determine the type of noise affecting the working image – specify it in a short comment. Based on the type of noise, choose a corresponding filter (filter type, size, kernel) that is best suited to remove the noise from the image.

Perform the filtering operation on the noisy working image, using the previously established filter kernel and save the filtered image with the name: *im_#_filt.jpg*.

Subsection 4.

Perform a color tone adjustment operation on the filtered image *im_x_filt* using the color tone curve specified in the assignment table next to your name. The curves indicate a mapping of the original colors in the image (black interrupted lines in the following plots) to values specified by the red/blue lines in the plots.

Tone_1	Curves for Red and Blue channels for warming effect. Green channel is not modified.	
Tone_2	Curves for Red and Blue channels for cooling effect. Green channel is not modified.	

Tone_3	One curve (in red) applied for all 3 channels (B,G,R) to decrease the contrast and increase the brightness.	
Tone_4	One curve (in red) applied for all 3 channels (B,G,R) to increase brightness in bright areas and increase contrast.	
Tone_5	One curve (in red) applied for all 3 channels (B,G,R) to make bright areas darker and decrease contrast.	
Tone_6	One curve (in red) applied for all 3 channels (B,G,R) to make dark areas darker.	
Tone_7	One curve (in red) applied for all 3 channels (B,G,R) to make bright areas brighter and dark areas darker.	

Indication: Specify the intensity values in the color channels on the original curve (black dashed line) that need to be modified as explained earlier (create an array with the horizontal axis points 0, 50, ...,250). Then, create the arrays with the new points on the Y-axis for each color channel. Make a Look-Up Table to store the interpolated values (`np.interp()`), so that you get a mapping from the original values to the modified values for each intensity level.

Use the Look-Up Table to map the pixel values in the original image to the output image for the respective color channels and merge the modified channels to get the final output. Use the function `cv2.LUT()`. Save the output image with the name: *im_x_tone.jpg*. An example is given in Figure 1.

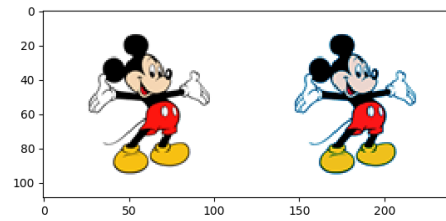


Figure 2. Original working image in the left and color tone adjustment to the right (cooling effect used in this example - Tone_2)

For more information regarding a Look-Up Table, check the following links:

https://docs.opencv.org/3.4/d2/de8/group_core_array.html#gab55b8d062b7f5587720ede032d34156f

<https://www.pyimagesearch.com/2015/10/05/opencv-gamma-correction/>

Subsection 5.

Overlap the character from the image obtained in Subsection 4, *im_x_tone*, on the background *back_eq_crop* obtained in Subsection 2. Use the mask from the image “#_alpha.jpg” (check your assigned image in the table) to segment that character. Then place the cropped area with the character in it inside the original background image, as shown in the example below. Save this final image as *im_x_final.jpg*.

!!! Do not use “blend” or other fancy algorithms from OpenCV! Work with the given images using arithmetic’s operations, as previously done in Laboratory_1 with Trump’s moustache!



Figure 3. Left side: cropped are from the background image and character mask. Middle: image resulted from overlapping the character working image on a background crop image. Right side: final background image with character in it.

<i>Student</i>		<i>Group</i>	<i>Background image</i>	<i>Working image</i>	<i>Color tone curve</i>
ANDREESCU	Radu-Mihai	443C	landscape2.jpg	2_noisy.jpg	Tone_1
ANGHEL	Alexandru-Petruț	442G	landscape1.jpg	3_noisy.jpg	Tone_2
BANȚĂ	Bogdan-Gabriel	441G	landscape7.jpg	4_noisy.jpg	Tone_3
BĂDIȚĂ	Violeta-Nicoleta	445C	landscape5.jpg	5_noisy.jpg	Tone_4
BĂLTĂREȚU	Marinela-Ionela	441C	landscape1.jpg	6_noisy.jpg	Tone_5
BERGHILĂ	Elena	442G	landscape6.jpg	7_noisy.jpg	Tone_6
CĂRUNTU	Dan-Gabriel	441C	landscape2.jpg	8_noisy.jpg	Tone_7
CHICAN	Costin-Andrei	442C	landscape3.jpg	1_noisy.jpg	Tone_1
CHIRA	Carmen Alexandra	442G	landscape2.jpg	2_noisy.jpg	Tone_2
CINCAN	Doru-Petruț	444C	landscape7.jpg	3_noisy.jpg	Tone_3
CONSTANTINESCU	Maria-Ecaterina	442G	landscape3.jpg	4_noisy.jpg	Tone_4
CORBU	Vlad	444C	landscape8.jpg	5_noisy.jpg	Tone_5
COSTEA	George	441C	landscape2.jpg	6_noisy.jpg	Tone_6
DEMIDOV	Oana	441G	landscape4.jpg	7_noisy.jpg	Tone_7
DEPĂRĂȚEANU	Maria	445C	landscape2.jpg	8_noisy.jpg	Tone_1
DOBRE	Alexandru Ștefan	444C	landscape8.jpg	1_noisy.jpg	Tone_2
DOBRIN	Cosmin-Iulian	442G	landscape3.jpg	2_noisy.jpg	Tone_3
EFTIMESCU	Dan Victor	444C	landscape9.jpg	3_noisy.jpg	Tone_4
ELISEI	Ștefan-Sergiu	444C	landscape3.jpg	4_noisy.jpg	Tone_5
ENACHE	George-Vlad	441G	landscape9.jpg	5_noisy.jpg	Tone_7
FETCU	Andrei - Octavian	441C	landscape2.jpg	6_noisy.jpg	Tone_1
GEANTĂ	Ionuț-Daniel	441C	landscape1.jpg	7_noisy.jpg	Tone_2
GHIORGHIU	Bianca-Alexandra	441G	landscape7.jpg	8_noisy.jpg	Tone_3
GHIȚĂ	Dan-Răzvan	444C	landscape5.jpg	1_noisy.jpg	Tone_4
GORGOI	Adriana-Elena	441C	landscape1.jpg	2_noisy.jpg	Tone_5
ILIE	Dragoș-Gabriel	442G	landscape6.jpg	3_noisy.jpg	Tone_6
MARINESCU	Georgian-Alexandru	441G	landscape2.jpg	4_noisy.jpg	Tone_7
MARINESCU	Mircea-Matei-Gabriel	442C	landscape3.jpg	5_noisy.jpg	Tone_1
MIHAI	Marius-Răzvan	443C	landscape2.jpg	6_noisy.jpg	Tone_2
MIRON	Marian-Bogdan	442G	landscape7.jpg	7_noisy.jpg	Tone_3
NEAGA	Iulian-Costin	445C	landscape3.jpg	8_noisy.jpg	Tone_4
NUTU	Raluca-Maria	441G	landscape8.jpg	1_noisy.jpg	Tone_5
ONOSE	Alexandru-George	444C	landscape2.jpg	2_noisy.jpg	Tone_6
OTOPELEANU	Radu-Andrei	442C	landscape4.jpg	3_noisy.jpg	Tone_7
PINTILIE	Florin-Cristian	441C	landscape2.jpg	4_noisy.jpg	Tone_1
PÎRLICI	Adelina-Maria	442C	landscape8.jpg	5_noisy.jpg	Tone_2
PODARU	Ștefan	442G	landscape3.jpg	6_noisy.jpg	Tone_3
POP	Andrei	441C	landscape9.jpg	7_noisy.jpg	Tone_4
PREDA	Andreea-Cristina	442G	landscape3.jpg	8_noisy.jpg	Tone_5
PREOTEASA	Alex-Petrișor	441G	landscape9.jpg	1_noisy.jpg	Tone_7
PRIMINESCU	Raluca-Elena	443C	landscape2.jpg	2_noisy.jpg	Tone_1

RADU	Cătălin-Mihai	441G	landscape1.jpg	3_noisy.jpg	Tone_2
RUSAN	Horia-Alexandru	442C	landscape7.jpg	4_noisy.jpg	Tone_3
SAVU	Mădălina-Cristina	442G	landscape5.jpg	5_noisy.jpg	Tone_4
SIMON	Andra-Elena	443C	landscape1.jpg	6_noisy.jpg	Tone_5
STANA	Ștefan-Roberto	442G	landscape6.jpg	7_noisy.jpg	Tone_6
STERIAN	Vlad	442G	landscape2.jpg	8_noisy.jpg	Tone_7
STROESCU	Ioana-Miruna	442C	landscape3.jpg	1_noisy.jpg	Tone_1
SUCIU	Antonia-Maria	442G	landscape9.jpg	2_noisy.jpg	Tone_4
TOMA	Bogdan	441G	landscape2.jpg	3_noisy.jpg	Tone_2
TUDORACHE	Vlad-Adrian	442C	landscape7.jpg	4_noisy.jpg	Tone_3
VÎNTURIȘ	Ramona-Maria	443C	landscape3.jpg	5_noisy.jpg	Tone_4