BINUS University

Academic Career: ***Undergraduate / ~~Master~~ / ~~Doctoral~~ *)***			**Class Program:** ***~~International~~/Regular/~~Smart Program~~/Global Class*)***		
☑ **Mid Exam** ☐ **Final Exam** ☐ **Short Term Exam** ☐ **Others Exam : _____**			**Term : Odd/~~Even~~/~~Short~~ *)**		
☑ **Kemanggisan** ☑ **Alam Sutera** ☑ **Bekasi** ☐ **Senayan** ☐ **Bandung** ☐ **Malang**			**Academic Year :** **2020 / 2021**		
Faculty / Dept.	:	School of Computer Science	Deadline	Day / Date :	Tuesday / Nov 10th, 2020
				Time :	17:00
Code - Course	:	COMP7116 - Computer Vision	Class	:	All Classes
Lecturer	:	Team	Exam Type	:	Online
*) *Strikethrough the unnecessary items*					
The penalty for CHEATING is DROP OUT!!!					

Note:

1. Please finish all ESSAY questions below.

2. Please answer the question in JUPYTER NOTEBOOK:

I. To explain your answer, you must use Markdown cell

II. To implement the algorithm or calculation, you can use Code cell

3. If needed, you can insert image which exist in Edit Menu

4. Please submit PDF and IPYNB files in ZIP as your FINAL REPORT.

1. **Point processing transformations (25%)**

These are four-point *processing transformations:*

- *Thresholding*
- *Gray-scaling*
- *Negative transformation*
- *Histogram Equalization*

a. Please explain the basic concepts of above *point processing transformations*. Complete your explanations with the mathematical equations of the transformations.

b. Furthermore, please download the image from this URL: https://qrgo.page.link/YNzeX
The first step is you load the image (lena_color.gif) and implement all above *point processing transformations*. It can be done by using OpenCV library.

2. **Convolution (25%)**

Please download the image from this URL: https://qrgo.page.link/Vt7Ag
The first step is you load the image (opera_house.jpg) and convert it into grayscale. It can be done by using Pillow library.

And the two 3x3 kernels

Verified by,

Hady Pranoto. S.Kom, M.T.I. (D1832) and sent to Program on Oct 20, 2020

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

1	0	-1
1	0	-1
1	0	-1

Please find the solution for: Convolution operation without border padding

a. Implement the above calculations using Numpy library.
b. Convert above numpy array to images and show the results. The implementation can use Pillow library.

3. **Harris corner detector (25%)**

Please answer below questions related to Harris corner detection as follow:

a. Explain the basic idea to detect the *Corner Points* in an image
b. If M is *second moment matrix* of *image derivatives*, please explain mathematically how to classify *image points* based on M Matrix!
c. Harris corner detector algorithm is based on above idea, together with additional step to enhance the detector. Please explain each step of Harris corner detector based on its original paper:

C.Harris and M.Stephens. "A Combined Corner and Edge Detector", Proceedings of the 4th Alvey Vision Conference: pages 147—151, 1988

d. Please download the image from this URL: https://qrgo.page.link/jNBDK
The first step is you load the image (checkerboard_101.png) and implement Harris corner detector. It can be done by using OpenCV library

4. **Canny edge detector (25%)**

Canny edge detector was developed by John F. Canny in 1986 and uses a multi-stage algorithm to detect multiple edges in an image. **Briefly describe the procedures involved in each stage, implement and apply it to this image from this URL: https://qrgo.page.link/HVHsH**

a. *Noise Reduction.* For this purpose, what kind of filter is used? And why is this stage very important to do in the first place? Explain it!
b. *Finding Intensity Gradient of the Image.* What does this stage produce? And what filters do you use to achieve it?
c. *Non-maximum Suppression*. What is meant by this stage?
d. *Hysteresis Thresholding.* What is the purpose of this stage? How do you perform double thresholding to achieve this goal?

-- Good Luck --

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