COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Artificial Intelligence (Alamein Branch)
Lecturer : Dr. Mohamed Waleed Fakhr
Course Name : Digital Image Processing & Pattern Recognition
Course Code : IN 322 **Total Marks: 22**
Date 22/5-2023 **Time allowed: 90min**

Question 1:

135	135	129	133	130	134	134	137
133	133	132	132	135	127	**55**	119
132	127	**222**	**200**	**65**	**55**	96	110
110	104	**210**	**65**	**55**	103	129	160
105	112	**65**	*45*	**250**	201	219	231
167	**65**	**55**	223	216	231	240	238
221	**55**	240	223	214	216	218	219
224	217	222	214	215	217	219	220

$M_x =$ | -1 | 0 | 1 | / | -2 | 0 | 2 | / | -1 | 0 | 1 | ; $M_y =$ | 1 | 2 | 1 | / | 0 | 0 | 0 | / | -1 | -2 | -1 |

For the (8-by-8) image block given, It is required to do edge detection using the shown Sobel operators (assume the image has already been smoothed with a Gaussian filter):

a) Apply the x-gradient and y-gradient Sobel operators shown above to pixel $[f(5,4) = 45]$ → Find the values for Δ_y *and* Δ_x **(2)**

b) Using the values from (a), Calculate the **strength and orientation** of the gradient at that pixel. Does the orientation angle make sense according to the edge direction you see in the block? **(3)**

c) In the Sobel edge detection we apply the following processes $\Delta_x = M_x^{Sobel} * \{g(x,y) * f(x,y)\}$ and $\Delta_y = M_y^{Sobel} * \{g(x,y) * f(x,y)\}$. Explain **what will be different** if you want to use the Canny edge detection (**Re-Write the equations in this case**). **(2)**

d) Explain **Two reasons** why the Canny approach is better than the Sobel approach. **(1)**

Question 2:

(a) For the 8-by-8 image above in Q1, apply the given Gaussian filter on pixel $\boldsymbol{f(5,4) = 45}$ and find the pixel's new value. Has it been smoothed? Is this smoothing good or bad and why? **(2)**

0.075	0.124	0.075
0.124	0.204	0.124
0.075	0.124	0.075

(b) Explain the main ideas of the **Bilateral Filter** and the **Non-local filter** approaches and show how they would avoid Blurring the edge in the above 8-by-8 block. **(2)**

(c) Apply an Adaptive Median Filter on the above block centered at pixel $\boldsymbol{f(5,4) = 45}$**. Take initial window size=3 and (maximum) window size=5 (use only odd window size).**
Find the new value for the pixel. Has it been blurred? (3)

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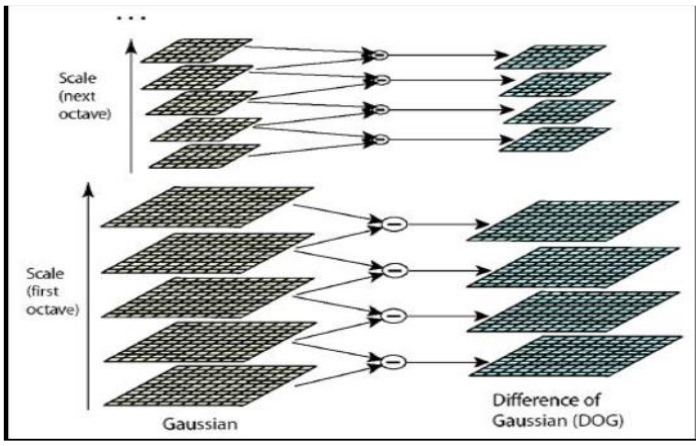
Question 3:



(a) **Explain using equations**: Why and How the Laplacian of Gaussian is used to detect blobs and how the Gaussian width "σ" determines the scale of the detected blob **(2)**

(b) Using the scale-space figure shown above explain **How** the difference-of-Gaussians (DoG) approach is used to find blobs in an image. **(2)**

(c) Explain How many blob scales can be detected using **Only the 2-Octaves** in the above structure. **(1)**

(d) $$\hat{F}(u,v) = \frac{G(u,v)}{H(u,v)} = F(u,v) + \frac{N(u,v)}{H(u,v)}$$

The above equation explains the inverse Filtering approach for image degradation removal. Define each term in the equation showing what was the equation of the degraded image, what is $H(u,v), F(u,v) and\ N(u,v)$ and how can we obtain the restored image in the spatial domain. **(2)**