Student Answer Script View

MIT MPL-BTech-M Sc - MCA - 1st-3rd-5th and 7th Semester - Mid Term Examination - Sep 2024

Answer Sheet

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Year/Sem:	Semester 5
Subject Name:	FOUNDATION OF COMPUTER VISION
Exam Date:	27-Sep-2024

Q.No : 1)

Which of the following statements accurately describes the role of zero crossing in edge detection, particularly when usi
the Laplacian of Gaussian (LoG) method?

Zero crossing occurs when the image intensity gradient is at its maximum value, indicating the location of an edge.	Zero crossing is the point where the Laplacian of the image, computed after Gaussian smoothing, changes sign, which helps to locate edges by indicating significant changes in intensity.	Zero crossing represents the point where the Gaussian filter itself crosses zero, indicating regions of low texture or uniformity rather than edges.	Zero crossing in edge detection algorithms is used to identify regions where the first derivative the image intensity reach zero, suggesting the presence of an edge.

Q.No : 2)

In the context of image thresholding techniques, which of the following statements accurately describes the application a implications of adaptive thresholding compared to global thresholding?

Adaptive thresholding involves using a predefined set of thresholds for different image regions, which are applied uniformly, regardless of local variations in image intensity.	Global thresholding uses local image properties to determine a single threshold value, which is then applied uniformly across the entire image, making it less effective for images with varying lighting conditions.	Adaptive thresholding calculates a different threshold value for each pixel based on local neighborhood statistics, making it more robust to variations in illumination and noise compared to global thresholding.None of the above.	Adaptive thresholding involves using a predefined set of thresholds for different image regions, which ar applied uniformly, regardless of local variations in image intensity.

Q.No : 3)

In SIFT descriptor, scale space peaks are detected using

Difference of Gaussian (DoG) is used as a preliminary step, followed by a refined analysis using the Laplacian of Gaussian (LoG) to detect more accurate scale-space peaks	Laplacian of Gaussian followed by Difference of Gaussian to detect more accurate scale-space peaks	Single Gaussian kernel is applied to multiple scaled versions of the image, and scale-space peaks are detected by analyzing the Gaussian responses.	Difference of Gaussian (DoG) is used directly to detect scale-space peaks

Q.No : 4)

Which of the following statements best describes the role of adding one to the input intensity in the logarithmic transformation process?

Adding one primarily improves the contrast of high-intensity regions by shifting the input values, and indirectly handles zero values and enhances numerical stability by avoiding logarithm calculation issues.	Adding one ensures that the logarithmic function is defined for all pixel values, including zero, and enhances the numerical stability of the transformation by preventing undefined results, while also compressing the dynamic range to highlight details in low-intensity regions.	Adding one increases the output intensity values for high-intensity regions, making the transformation less effective for handling zero values and low-intensity regions but simplifying the contrast adjustment for bright areas.	Adding one modifies the scaling factor of the transformation, making it easier to compress the dynamic range of the imag but does not affect the definition of the logarithmi function for zero values.

Q.No : 5)

Which of the following statements is accurate regarding the roles and implications of bitplane slicing in image processin

Manipulating the middle bit planes has little effect on the image's contrast or visibility of details since these planes contain redundant information. The least significant and most significant bit planes are the primary sources of visual information and contrast.	The least significant bit plane is crucial for the overall image perception as it holds significant visual information, while the most significant bit plane provides fine details. Discarding the least significant bits generally degrades image quality significantly.	The most significant bit plane provides the primary visual information and overall structure of the image, while the least significant bit plane mainly contains noise and less critical information. Discarding the most significant bits results in noticeable loss of image quality.	Including the middle bit planes (e.g., Bit Plane 4 and Bit Plane 5) is detrimental to image quality, as these planes a responsible for image details.

Q.No : 6)

For the following Harris corner detector formulation,

$$E(u,v) = \sum_{x,y} w(x,y)\left[I(x+u, y+v) - I(x,y) \right]^2$$

(a) Derive the second order moment matrix M.

(b) Discuss how eigen values computed from M are used to detect a corner point.

(c) Write the Harris corner response function using the eigen values .

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(a) $E(u,v) = \sum_{x,y} w(x,y) \left[I(x+u, y \quad I(x,y) \right]$

Using taylor series -

$E(u,v) = \sum_{x,y} w(x,y) \left[\cancel{I(x,y)} + uI_x + v \quad \cancel{I(x,y)} \right.$

$E(u,v) = \sum_{x,y} w(x,y) \left[uI_x + vI_y \right]$

$= \sum_{x,y} w(x,y) \begin{bmatrix} u \\ v \end{bmatrix} \begin{bmatrix} I_x & I_x \\ I_y & I_y \end{bmatrix}$

$= \sum_{x,y} w(x,y) \begin{bmatrix} I_x^2 & I_{xy} \\ I_{xy} & I_y^2 \end{bmatrix}$

b) The eigen values are computed from .

solving $|B - \lambda I| = 0$

where = $B = det(M) - \alpha (trace(M))^2$

where M is the second order moment matrix $= \sum_{x,y} w(x,y) \begin{bmatrix} I_x^2 & I_{xy} \\ I_{xy} & I_y^2 \end{bmatrix}$

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w(x, y) is the window function usually Gaussian.

On the solving the equation, we get the eigen values, if both the eigen values large enough then it is a corner, if eigen value is large and other is sma then it is an edge otherwise, its a

3) Response function is

$$\det(M) - \alpha(\mathrm{trace}(M))^2$$

where M is the second order moment matrix M.

Q.No : 7)

2. Given the probability density functions Pr(r) and Ps(s) of random variables r and s in the intensity interval [0, L-1], prove that in histogram equalization, resulting int distribution, Ps(s) = 1/(L-1).

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$$P_s(s) = T(r) = (L-1)\int_0^r P_r(w)\, dw$$

$$(L-1)\int_0^r \frac{1}{2\pi\sigma^2} e^{\frac{-r^2}{2\sigma^2}}$$

$$= \frac{1}{L-1}$$

Q.No : 8)

With respect to Scale Invariant Feature Transform, what are the two steps for key point localization.

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Key point localization is the ~~step~~ the low contrast points and noisy are eliminated.

Two

Q.No : 9)

What are the expectations from a good feature detector algorithm? Describe the steps involved in feature matching.

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Expectations from a good feature detector are —

1) It should be scale invariant

2) It should be illumination, rotation invariant.

Q.No : 10)

Consider an imaginary gray level profile containing ramp, step, and horizontal line. How does filters masks derived from first order and second order derivatives respo

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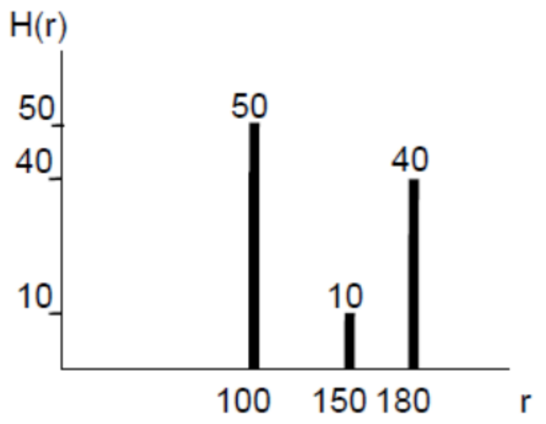
for a horizontal line, first order der would be zero and second order derivat would be non-zero. Therefore, the first order derivative mask would be image, whereas the second derative mask be an horizontal thin line of a particular int and background will be black.

- for a step, first order derivative w be non-zero and second order derivative will be zero and the second order m would be completely black

- for a ramp, both the first order an second derivative will be non-zero, wi second-order derivative more finer and thinner - l first order.

Q.No : 11)

The basic global thresholding algorithm is applied to an image with the histogram as shown below in following figure. Find the global threshold? Assume that the initi threshold is somewhere between the minimum and maximum values in the image.



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Let initial threshold be 140

∴ Intensities which are less than 140 are 100 and no. of pixels = 50

∴ The average intensity in this segment =

The pixels which have intensities greater : 140,

mean intensity value = $\frac{10 \times 150 + 40 \times 180}{50}$

$= 174$

∴ The threshold will be $= \frac{1}{2}(m_1 + m_2)$

$= \frac{1}{2}(174 + 100)$

$= 137$

Q.No : 12)

Mathematically show that sum of differences used in Harris corner detector is same as correlation operation.

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$$\sum\sum(f(x,y) - h(s,t))$$

Q.No : 13)

How do you detect all the edges in a given image that are oriented in different directions?

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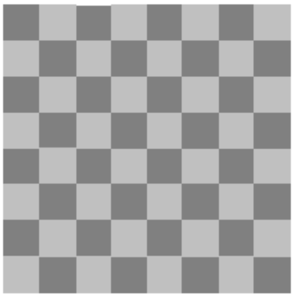
You can detect all the edges in a given image that are oriented in different directions by the finding the derivative HOG transformation.

Q.No : 14)

The images below are quite different, but their histograms are the same. Suppose each image is blurred with a 3x3 box filter smoothing mask. Would the histograms sti
blurring? Justify your answer.



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No, the histograms will not be identic
after blurring, because when the
filter is applied which is $\frac{1}{9}\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix}$
if size is 3x3, when we apply conv
the no. of pixels of each intensity will
be same in both the image, theref
histogram will be different