

資訊網路與多媒體研究所
博士班基本學科考試:數位影像處理

1. (40%)

You are required to give a brief explanation of your answer wherever applicable.
No credit will be given for no reason or for wrong reason.

- (a) (True/False) The gradient magnitude can be computed by a convolution.
- (b) (True/False) The second order derivative of an image can be computed by a convolution.
- (c) (True/False) The Laplacian operator is useful in calculating the rate of intensity change and direction of an edge.
- (d) (True/False) A Wiener filter can be reduced to an inverse filter.
- (e) What is a free variable in perspective transform?
- (f) What is full-scale histogram stretch? What is histogram equalization? What is the difference between them?
- (g) What is the difference between orthogonal and perspective transforms?
- (h) What is a high dynamic range image?
- (i) How to avoid aliasing while sampling an image?
- (j) Please compare the performance of spatial- and frequency-domain low-pass filters.

2. (25%)

The reference point is important to the image rotation operation. For an image of size $(N + 1) \times (N + 1)$, consider three ways to choose the reference point. The first one is the centroid of the image (O_1), the second one is the bottom left corner of the image (O_2) and the third one is the origin which is located at $(0,0)$ (O_3) as shown in Fig 1. The upper right corner of the image is $p(x,y)$. Furthermore, we use p_1 , p_2 and p_3 to denote the locations of $p(x,y)$ after rotating the image counter-clockwise by an angle of q with respect to reference points O_1 , O_2 and O_3 , respectively. Please determine the coordinates of p_1 , p_2 and p_3 and the spatial relationship among them.

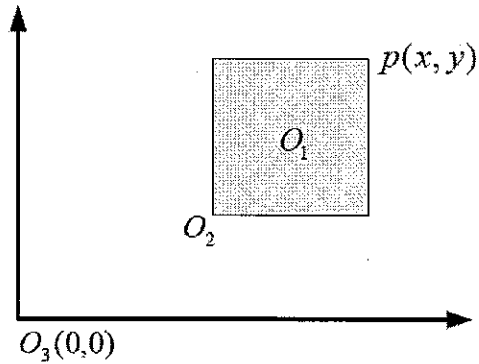


Fig. 1: image rotation with respect to three reference points

3. (20%)

Given an image with dynamic range of $[0,15]$. The following table shows the number of pixels at each intensity value.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
20	25	25	20	20	25	20	25	25	20	20	25	25	25	20	20

- Please draw the histogram of this gray-level image.
- Perform histogram equalization and draw the histogram of the resultant image.
- Please discuss on the visual quality of the original image and the equalized one based on their histograms.

4. (15%)

Consider an image given in Fig. 2. Please describe an algorithm step by step to count the number of characters in the image.



Fig.2