

## 博士班基本學科考試：數位影像處理

2013 年 9 月 26 日

1. (20%) You are required to give a brief explanation of your answer wherever applicable. No credit will be given for no reason or wrong reason.
  - (a) Every point in an image at which the second directional derivative is zero is an edge point.
  - (b) The Laplacian operator is useful in calculating the rate of intensity change and direction of an edge.
  - (c) What is the purpose of multiplying  $(-1)^{j+k}$  of an image  $f(j,k)$  before computing its Fourier transform?
  - (d) Please explain the reason why the noise is added when performing dithering for digital halftoning.
2. (30%)
  - (a) (15%) Please use mathematical expressions to state the definitions of ideal low-pass filter, Butterworth low-pass filter and Gaussian low pass filter, respectively.
  - (b) (15%) What are pros and cons of each filter mentioned in part(a)?
3. (25%) Design a morphological algorithm to extract out characters 'b', 'd', 'p' and 'q' in the following image. Please describe each step clearly including operations, structuring elements and intermediate results.

This is the qualify exam of digital image processing in Fall 2013. Good Luck!

A prior information about the unknown binary image is that the percentage of black pixels is 17.51%. Given the original Lena image and final image (one binary image is embedded), try to find out the embedded binary image using histogram manipulation techniques and bit plane search. Note that depending on the method you choose the approximation to the original binary image may be different visual qualities. Please describe the procedure clearly.

4. (25%)
  - (a) (10%) A 200 x 200 image is expanding with the rate of 2 pixels per second in each dimension separately. Suppose the original image is  $F(i, j)$  and the expanded image after 10 seconds is  $G(i, j)$ , please calculate the pixel values for  $G(0, 0)$ ,  $G(120, 60)$  and  $G(16, 32)$  in terms of  $F(i, j)$ . (HINT: you may need to use the four-point bilinear interpolation).
  - (b) (15%) Develop a method to convert a square image (a) to a perfect elliptical image (b). Please describe your idea step by step. (You may assume that the

sizes of image (a) and (b) are given). If you use polynomial warping with 9 control points, is it possible to obtain the perfect elliptical contour in (b)? Please justify your answer.

