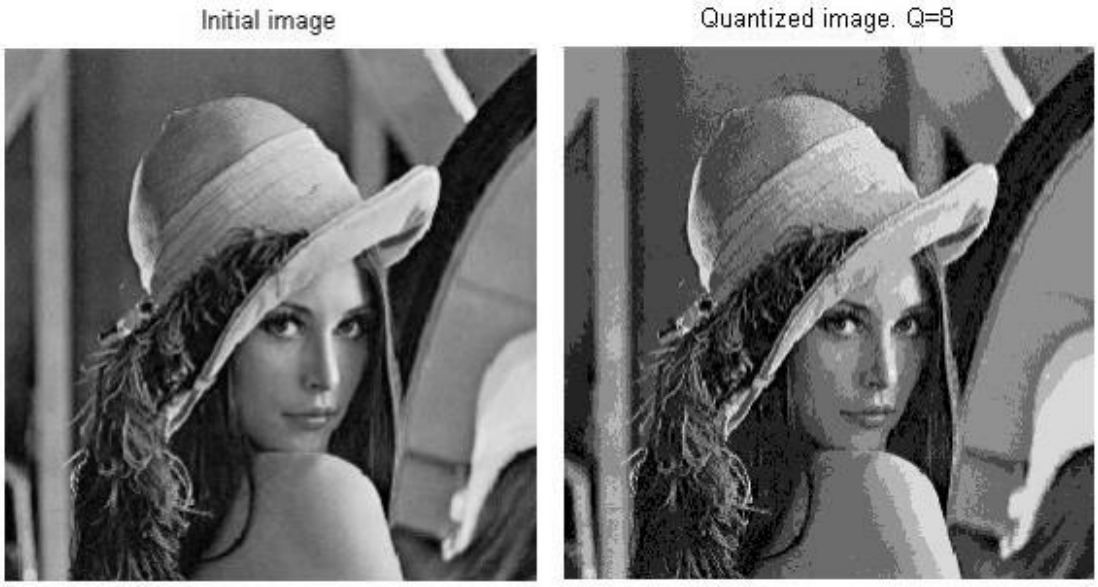
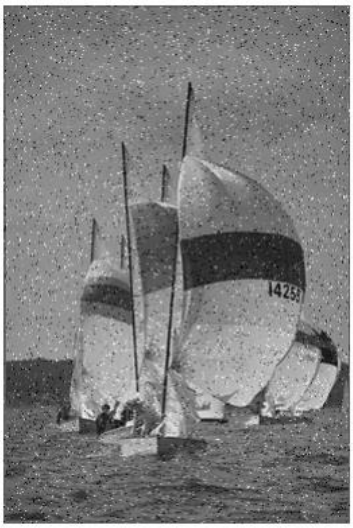
博士班基本學科考試：數位影像處理

2017 年 3 月 10 日

1. (10%)
   Explain the effect of reducing the quantization levels of the original Lena image from 256 (8-bit) to 8 (3-bit) as shown below. What causes these differences?



2. (20%)
   Suggest two spatial filtering methods to enhance given noisy image shown below:



   Compare the performance of the two filters in terms of noise reduction and preserving edges in the original image.

3. (20%)

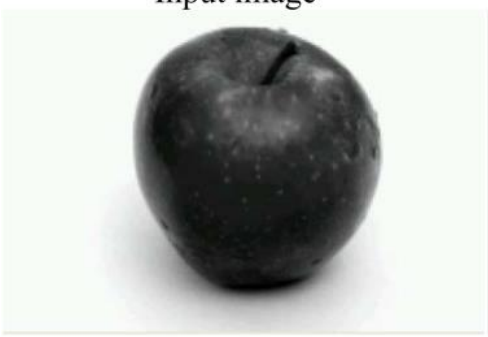
(a) Explain the effect of reducing the sampling rate to one-fourth in the original Barbara image shown below. What causes these differences?

Original Barbara image

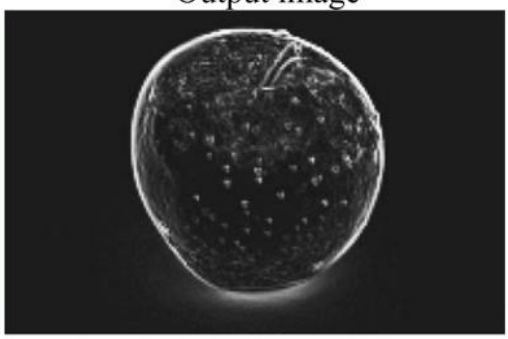
Barbara image with sampling rate reduced to one-fourth

(b) Considering the processed (resulting) image on the right image shown below, what would be the most likely (3x3) spatial filter applied to the input image on the left, specify its mask.

Input image



Output image



4. (20%)

Suppose that you form a low pass filter that averages the four immediate neighbors of a point (x, y), but excludes the point itself.

(a) Find the equivalent filter $H(u, v)$ in the frequency domain.

(b) Show that $H(u, v)$ is a lowpass filter.

5. (15%)

(a) What is the inverse filter?

(b) What is the Wiener filter? (Please try to write down the mathematical

expression.)

(c) When does the Wiener filter reduce to the inverse filter?

6. (15%)

Following questions are about Nyquist Rate. Consider the continuous function f(t) = cos(2016 **π** t).

(a) What is Nyquist rate? Explain it.

(b) What is the Nyquist rate of the continuous function given above?

(c) What will happen when the sampling rate of the continuous function equals 2000 ?