

CAP 5400 Digital Image Processing

Exam# 1 Nov 1, 1999 (Max Points: 100 + 10 (extra credit))

Name:

1. If the Fourier transform of a function, $f(x)$, is $F(u)$, what is the *magnitude* of the Fourier transform of $f(x + 5)$? (5 pts)
2. If the Fourier transform of a function, $f(x)$, is $F(u)$, what is the Fourier transform of $f^2(x)$? (5 pts)
3. If the Fourier transform of a function, $f(x)$, is $F(u)$, what is the Fourier transform of $f(-x)$? (5 pts)
4. If the Fourier transform of a function, $f(x)$, is $F(u)$, what is the Fourier transform of $f(5x + 8)$? (5 pts)
5. If the Fourier transform of a function, $f(x)$, is $F(u)$, what is the Fourier transform of $F(x)$? (5 pts)

6. Draw the Fourier transform of the following discrete function (15 pts)

$$f(n) = \begin{cases} A & \text{if } |n| < W, n \text{ is an integer} \\ 0 & \text{elsewhere} \end{cases} \quad (1)$$

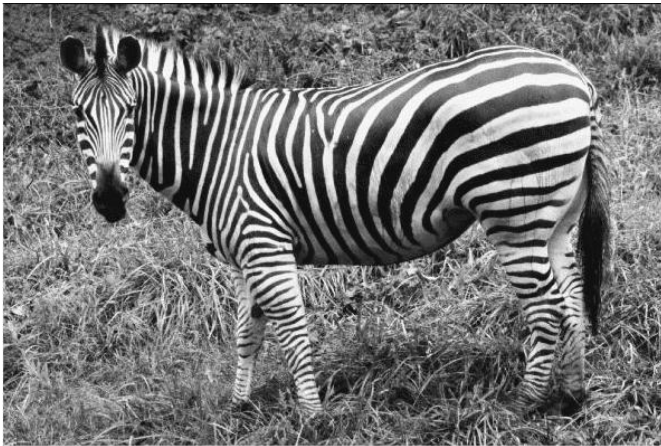
7. What is the Fourier transform of $f(x) = A$? (5 pts)

11. How is the Discrete Cosine Transform related to the KL transform? (5 pts)

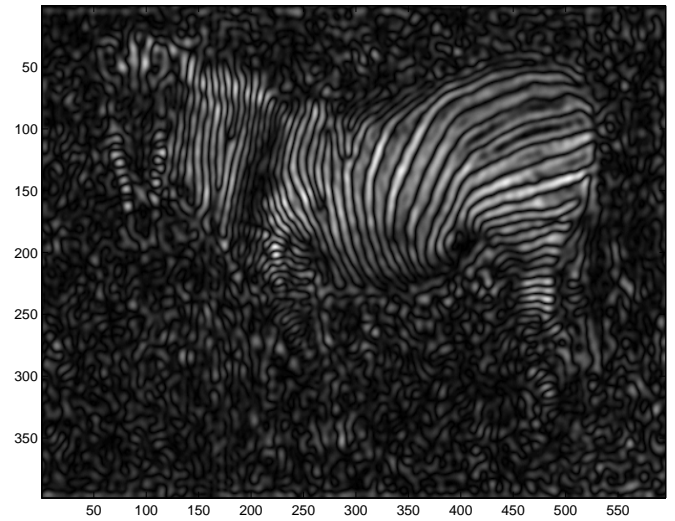
12. What is the Fourier transform of $r(x)$, defined below, in terms of the Fourier transform of $f(x)$ denoted by $F(u)$? (Note that this is not exactly the convolution integral, although it appear very much like it.) (20 pts)

$$r(x) = \int_{-\infty}^{\infty} f(x')f(x' - x)dx' \quad (2)$$

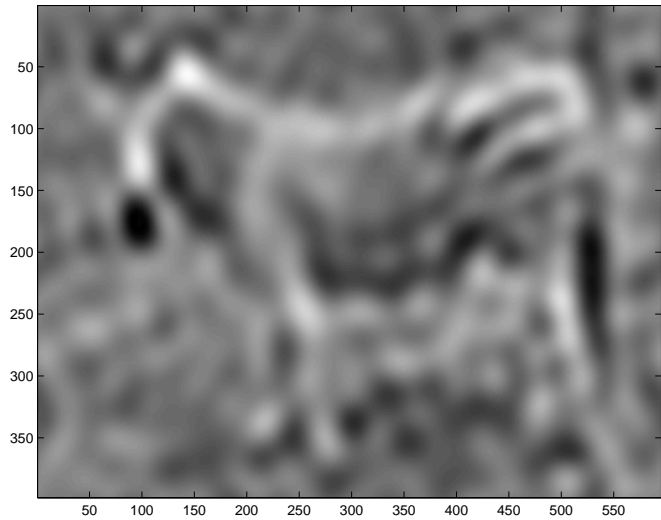
13. The image in (a) below shows an gray level image. The images in the other parts correspond to low-passed, high-passed, or band-passed version of (a), not necessarily in that order. Identify which of the images in (b), (c), and (d) is low-passed, which one is band-passed, and which one is high-passed? Justify your choices. (10 pts)



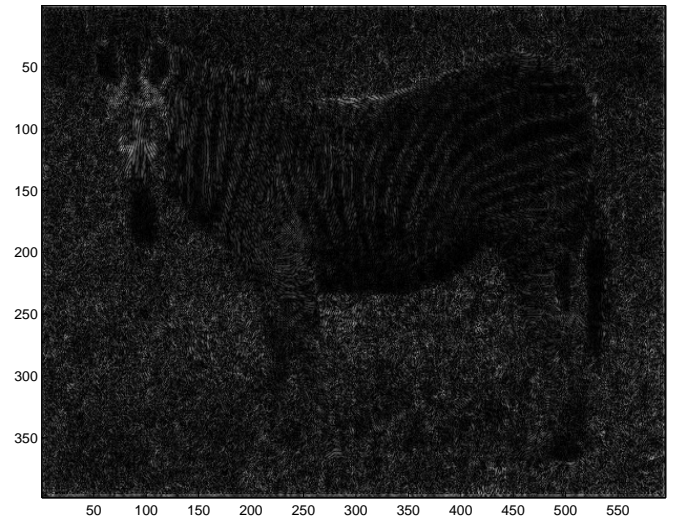
(a)



(b)



(c)



(d)



(a)



(b)

14. What artifact do you see in (a) that you do not see in (b)? Why does it arise and how can it be prevented from occurring. (10 pts)