

**EE 145B, Spring 1995**  
**Midterm #1**  
**Prof. Budinger**

**Problem #1**

A 256 point digitized signal of the electroencephalogram is Fourier transformed. The time domain sampling interval was 8 milliseconds. Where would you expect to find the amplitude of the 60 Hz noise signal?

**Problem #2**

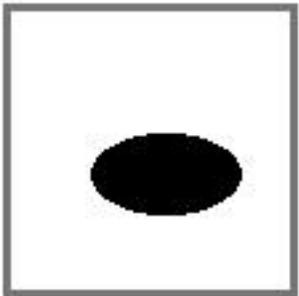
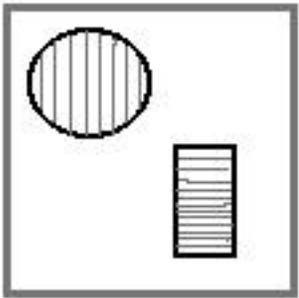
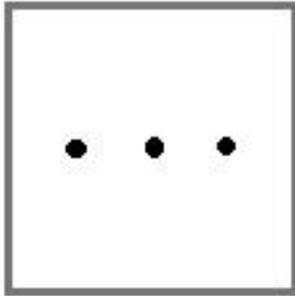
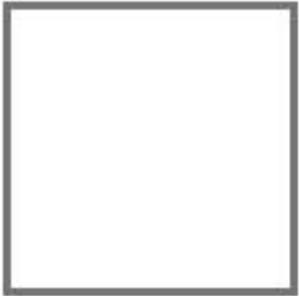
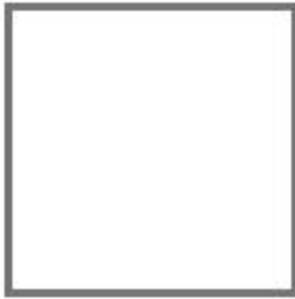
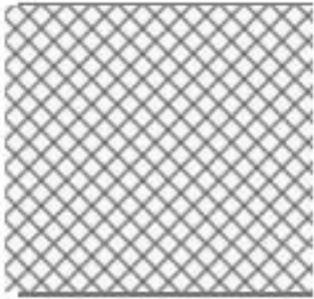
The Fourier Transform of a wave form has been calculated by the FFT and you cannot get to a printer or output device. Draw the original wave form.

| Real | Imaginary |
|------|-----------|
| 1    | 0         |
| 2    | 0         |
| 0    | 0         |
| 1    | 1         |
| 0    | 0         |
| 1    | -1        |
| 0    | 0         |
| 2    | 0         |



### Problem #3

The following are to be Fourier transform pairs showing the magnitude of the Fourier coefficients in two dimensions. Fill in the 4 empty image arrays.



## Problem #4

You are given an image which requires edge detection, but it is very noisy. You decide to apply some 2D filter techniques to arrive at a 2D diagram wherein only 2 gray levels are shown. One level is white and denotes an edge and the other level is black. Suppose the data array image is  $N \times N$ . Describe in a step-wise fashion (at least 10 steps) how you would proceed along the lines below.

1. Digitize the  $N \times N$  image.
2. Create a  $2N \times N$  array for FFT.

## Problem #5

- a) The histogram equalization method is to be applied to an image of  $32 \times 32$  wherein the gray levels go from 1 to 16: Show the steps needed to perform this non-linear processing.
- b) Describe in 20 words or less two methods of edge detection. Use diagrams if convenient.

## Problem #6

State in words:

- a) The Fourier transform of a one dimensional spatial function is.....
- b) There is a correspondence between the Fourier transform of an object and an optical lens system. State the correspondence.

## Problem #7

Using words such as "backproject" and "Fourier transform" show the sequence of operations for:

- a) Backprojection of filtered projection.
- b) Filtered backprojection.

**Problem #8**

You are given the following data

|     |     |     |
|-----|-----|-----|
| a1  | a2  | P=2 |
| a3  | a4  | P=8 |
| P=6 | P=4 |     |

Estimate the values of  $a$

Show your work

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