

### HW3

1. If a function  $f(x)$  has the Fourier transform  $F(\omega)$ , what would be the Fourier transforms of the following functions, in terms of  $F(\omega)$ , and why:

- a)  $f(-x)$
- b)  $f^*(x)$
- c)  $-f(x)$
- d)  $[f(x)]^2$
- e)  $\text{Re}(f(x))$

2. In Matlab, a two dimensional 16 x 16 checkerboard pattern can be formed using the following set of commands:

```
>> [x,y] = meshgrid(0:255,0:255);  
>> checkerboard = xor(mod(x,32)<16,mod(y,32)<16);
```

Calculate the two dimensional Fourier transform of the checkerboard using the `fft2` command in Matlab:

```
>> checker_ft = fftshift(fft2(checkerboard,256,256));
```

Note that the `fftshift` command is necessary to shift the center of the transform to the center of the matrix (a quirk of Matlab). Display this matrix as a magnitude image `[abs(checker_ft)]` and describe the results, making sure that you scale the image to observe the “high resolution” components of the transform. Now use Matlab to form a 4 x 4 checkerboard pattern and a 64 x 64 pattern, and determine their Fourier transforms as above. What property of Fourier transforms determines the relationship between the “resolution” of the checkerboards and pattern of intensity you observe in their FTs?