Transform Methods & Signal Processing
Class Exercise 4:
Hand in before lecture, 14th Sept

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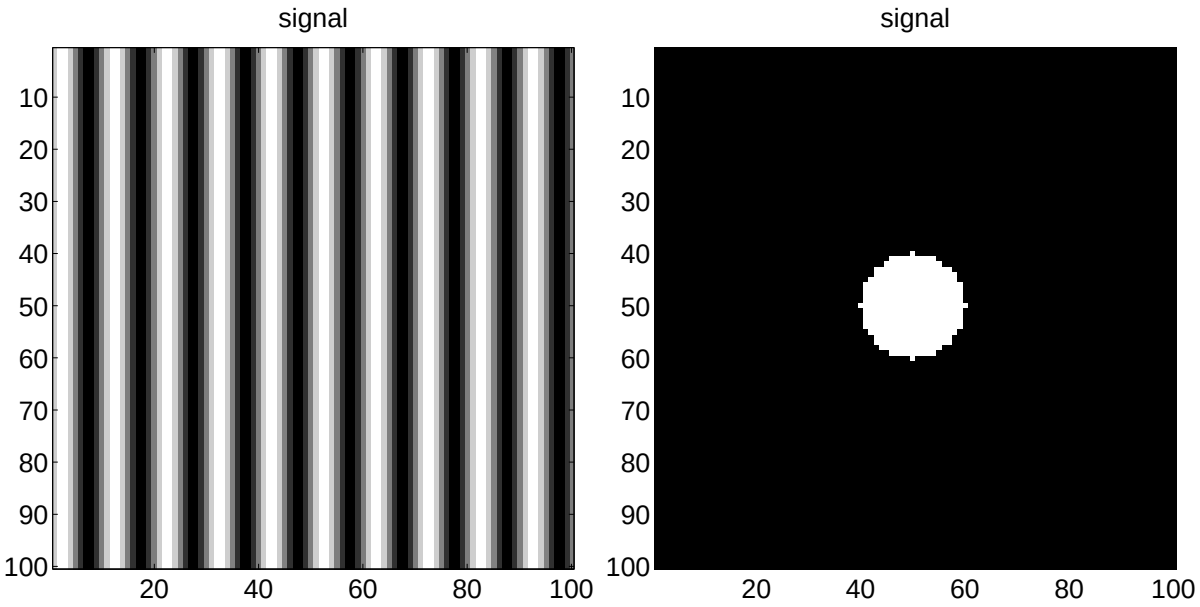
Note, questions marked by a (*) are harder than normal questions, and are for masters students. Bonus marks may be awarded to other students who solve these.

1. [4 marks] Look at the images displayed in figure below (the first is sinusoidal in one direction, and constant in the other, the second is zero outside, and one inside a circle). Describe what the power-spectrum of these images would look like.



2. [4 marks] Calculate the two-dimensional convolution of $f(x,y) = \delta(x)r(y)$ with $g(x,y) = r(x)\delta(y)$. Hint a 2D convolution is

$$[f * g](x,y) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x',y')g(x-x',y-y')\,dx'\,dy'$$

Derive the Fourier transform of this function.

3. [2 marks] Write down the natural generalization of the Fourier transform to 3 dimensions.

4*. [5 marks] Give the continuous Fourier transform of the following function

(a) $f(x,y) = \exp\left(-\pi(xcos(\theta) + y\sin(\theta))^2\right)$