Math 155
Final exam: Tuesday, March 21st, 3-6pm, MS 5118 (usual lecture room).
Additional office hours:
Monday, March 20:
- 10am-12pm with Baichuan
- 1-2pm with Vese.

Sample questions (but not limited to this list):
- What is the definition of

- the arithmetic mean filter ?
- the geometric mean filter ?
- the harmonic mean filter ?
- the contraharmonic mean filter ?
- the median filter ?
- the max and mean filters ?
- the midpoint filter ?
- the alpha-trimmed mean filter ?

• Give the main steps of an adaptive, local noise reduction filter ? (explain).

• Given examples of low-pass and high-pass filters and explain.

• Give the main steps of filtering in the frequency domain.

• Prove properties of the FT like those done in class or in the homework.

• What is the goal of a bandreject filter for periodic noise reduction ? Give an example. What is the goal of a bandpass filter ? Give an example.

• Explain the optimum notch filtering technique.

• Give the definition of a unite impulse, located at coordinates (x, y).

• Show that, if $g(x, y) = H[f(x, y)]$, with H linear, position invariant, and extending the additivity property to integrals, then H is given by a convolution with the function f.

• Show in continuous variables that the Fourier transform of

$$f(x, y)e^{2\pi i(u_0 x + v_0 y)}$$

is given by $F(u - u_0, v - v_0)$, where $F(u, v)$ is the Fourier transform of $f(x, y)$.

• Consider the motion degradation function

$$g(x, y) = \int_0^T f[x - x_0(t), y - y_0(t)]dt.$$

Find $H(u,v)$ such that $G(u,v) = H(u,v)F(u,v)$, where G and F are the Fourier transforms of g, f, respectively (show the details of the derivation).

• Give an example of degradation function h and explain how it is applied to the original image f ?

• What is the linear degradation model in the spatial domain and frequency domain ?

• Give an example of a restoration (deconvolution) model.

• Give an example of a mask w that can be used to detect:

- a light point on a constant dark background (explain)
- a light vertical line on a constant dark background (explain), etc.

• How can you detect edges using the gradient $\nabla^2 f$ of an image $f(x,y)$? Give an example of approximation to the gradient.

• Give the main steps of the zero-crossings method for edge detection (Marr-Hildreth edge detector).

• Recall the definition in continuous variables of the convolution

$$f(x,y) * g(x,y).$$

• Show the convolution Thm.

• Show that $\nabla^2(f*g) = f*(\nabla^2 g)$ at (x,y), where ∇^2 denotes the Laplace operator in (x,y).

See additional problems and exercises from the homework.