Math 155, Spring, Vese

Final exam: Friday, June 11, 1pm.
Review lecture: Wednesday, June 9, 1-1.50pm
Additional office hours: Thursday, June 10, 2-3pm, MS 7620-D.

Sections covered for the final exam:
- all sections covered for the midterm exam
and
- Sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11
- Sections 6.2.1, 6.2.3, 6.4, 6.5.1, 6.5.5, 6.6, 6.7.3
- Sections 10.1, 10.2.1, 10.2.2

Note that you may expect more questions from Chapters 5, 6 and 10, and fewer questions from Chapters 1-4.

Sample theory 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).
bullet 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 histogram equalization for color images.

• How can you obtain a sharper image using the Laplacian, for a color image in the RGB mode ?

• Give an example of 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)

• How can you detect edges uses 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.

• Recall the definition in continuous variables of the convolution

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

• 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 textbook.