Important: This is an open book test. You can use any books, notes, or paper.

1. [6 pt] What is the difference between erosion and geodesic erosion?

2. [8 pt] Mathematically define a *unit impulse* of a continuous variable t, located at $t = 0$. Then, modify this equation to one for an impulse located at $t = t_0$.

3. [8 pt] What is Nyquist rate? How does it relate to sampling theorem?

4. [8 pt] Why is an ideal lowpass filter known as a nonphysical filter? How do you compute its cutoff frequency?

5. [8 pt] When discussing median filters, we noted that using these filters generally results in less blurring than using linear smoothing filters (box lowpass filters) of the same size. Explain the reason for this phenomenon. You may assume that the noise is negligible and consider the behaviour of those filters in the neighborhood of a binary edge.

6. [8 pt] What type of noise can be best reduced by a frequency filter? What type of noise will be best reduced by a contraharmonic filter?

7. [8 pt] A binary image contains straight lines that are oriented horizontally. Give a 3×3 kernel that can be used to detect one-pixel breaks in these lines. Assume that the intensities of the lines and background are 1 and 0, respectively.

8. [6 pt] What is the difference between a step edge, a ramp edge, and a roof edge? What simple method do you propose to detect each of them?