CS 4/791E Computer Vision

Spring 2004 - Dr. George Bebis

Homework 2

Due date: 2/24/04

1. Convolve the subimage shown below with a 3x3 mean filter. What is the output of the convolution at the center entry of the subimage? What about if you use a 3x3 median filter?

4	1	6	1	3
3	2	7	7	2
2	5	7	3	7
1	4	7	1	3
0	1	6	4	4

2. Consider the subimage shown above. Find the gradient magnitude and gradient direction at the center entry using (i) the Prewitt operator, (ii) the Sobel operator.

3. Problem 3.4, page 65 (parts (a) and (b) only).

4. Prove the following properties of the Gaussian function $G(x) = e^{\frac{x^2}{2\sigma^2}}$:

(a) Symmetry: $G(x) = G(-x)$
(b) Scaling: $G^{\sigma}(x) * G^{\sigma}(x) = G^{\sqrt{2}\sigma}(x)$

Using property (b), propose a more efficient way to compute $(f(x) * G^{\sigma}(x)) * G^{\sigma}(x)$. Justify your answer by comparing the number of calculations (i.e., multiplications/additions) required.

5 The *facet model* represents an alternative approach to edge detection. Section 5.5 from the book "Machine Vision" (by Jain et al.) describes how the facet model works. Summarize the main ideas of the *facet model* and present the steps for edge detection using this model in an algorithmic fashion (e.g., like we did in class for the Canny edge detector).

6. Generate the mask for 255 x $\nabla^2 G(x, y)$, for σ=1. Truncate all the mask values to the nearest integer (*Hint:*: write a program).