The University of Western Ontario
Computer Science CS630a
Final Examination - December 14th, 2005

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This exam consists of 5 questions (8 pages, including this page) worth a total of 100%. It is an open book exam. All answers are to be written in this booklet. Scrap work may be done on the back of each page; this will not be marked. The exam is 2 hours long and comprises 30% of your final mark. Assignments 1 and 2 are each worth 35% respectively, for a total of 70%.

(1) 20%
(2) 20%
(3) 20%
(4) 20%
(5) 20%
Total

Professor: John Barron
Answer the following questions briefly and concisely and show all relevant work. Where possible, use point-form. Generally, correct answers will be short.

(1) (20%) Consider the morphological operators of dilation \( (\oplus) \) and erosion \( (\ominus) \). Consider the binary image shown in Figure 1 below.

![Figure 1: A binary image A and a 2 × 2 structuring element X. The origin of X is the pixel in the lower left hand corner.](image-url)
(1a) (7%) Show the dilation and erosion (opening) of image $A$ by $X$ below. Show your shaded results in pencil if possible. This will allow you to make corrections.

$A \oplus X$ \hspace{1cm} $(A \oplus X) \ominus X$

[Hint: remember in the calculation of dilation or erosion, that the origin of the structuring must be place as each pixel in order to determine that’s pixels effect from the dilation or erosion.]
(1b) (7%) Show the erosion and dilation (closing) of image $A$ by structuring element $X$ below.

\[
A \ominus X \quad (A \ominus X) \oplus X
\]

(1c) (6%) Which operation (opening or closing) seems to be best for joining gaps (assuming that $A$ should be a closed object) and why?
(2) (20%) Consider a convex shape being represented by either chain codes and shape signatures. Which is best and why for each of the following conditions:

1. Size is not an issue but orientation is.

2. Orientation is not an issue but size is.

3. Both size and orientation are issues.

4. The shape is not convex.
(3) (20%) Why is the Log Spectrum rather than just the Spectrum typically used to display the FT of an image?
(4) (20%) Consider performing segmentation via an DOG edge operator, region growing or the watershed algorithm. List an advantage and disadvantage for each approach.

DOG edge operator advantage:

DOG edge operator disadvantage:

Region growing advantage:

Region growing disadvantage:

Watershed algorithm advantage:

Watershed algorithm disadvantage:
(5) (20%) Consider a camera that yields images with noise spikes that randomly occur at about 5\% of the frequencies in the Fourier domain. How might you go about eliminating (or, at least, significantly attenuating) this noise?