HoChiMinh City, University of Technology
Faculty of Electrical & Electronics Engineering
Department of Telecommunications Engineering
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Final Examination
Introduction to Image & Video Processing
Date: Monday December 22, 2014
Time Allowed: 120 Minutes (12h30 - 14h30)

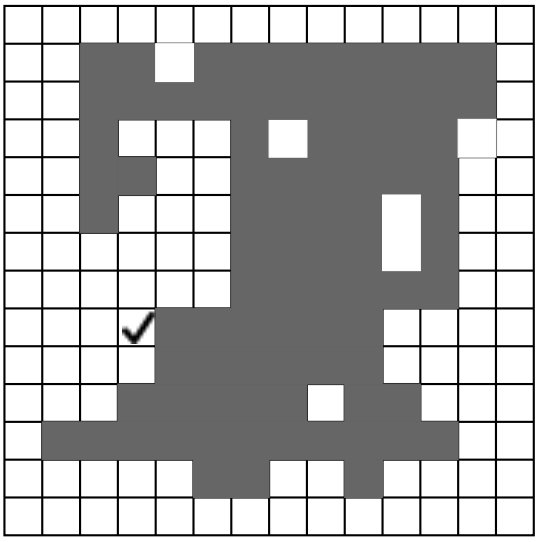
Student name: ..... Student ID: ..... Group: .....

Your Points	Invigilator	Lecturer	Head of DTE
		Dr. Anh Viet-Nhat Che	

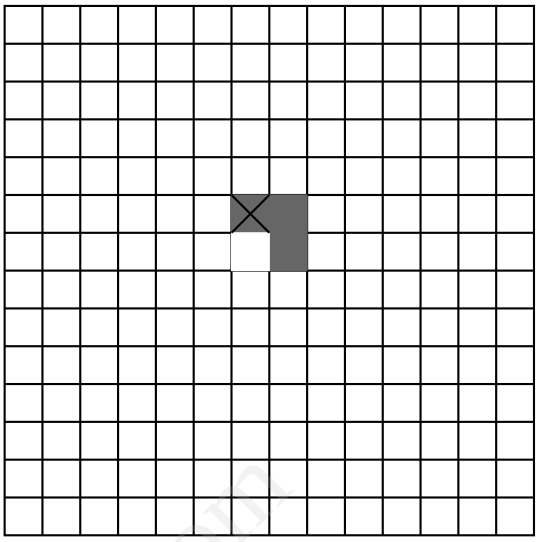
1. This exam has **8 pages, 4 questions, for a total of 100 points**.
2. Books and lecture notes are allowed on the exam. Use of calculator is permitted, but computers, tablet, and cellular phones are not allowed.
3. Read questions carefully and answer what is asked for. If something is unclear, make the assumptions you need to clarify it, and be sure to write down your assumptions.
4. Answer the questions in the spaces provided next to the questions. You may use the back of the page for extra space. If you need extra space for an answer, you are probably on the wrong track.
5. It will be to your advantage to read the entire examination before beginning to work.
6. Good luck!

Question	1	2	3	4	**Total**
Points	20	20	15	45	100
Score					

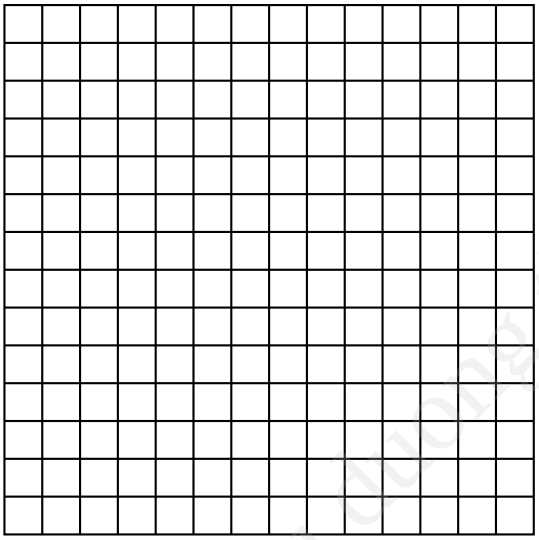
Question 1 (20 **Points**) For the Image A in Figure I.1, using the Structuring Element B in Figure I.2, determine the closing and opening of A by B. You can use the grids in Figure I.3 (Figure I.4) and Figure I.5 (Figure I.6) to draw the intermediate and the final results.



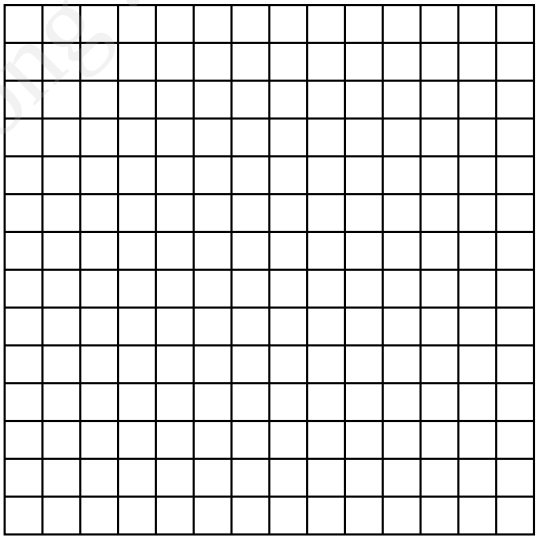
Hình I.I



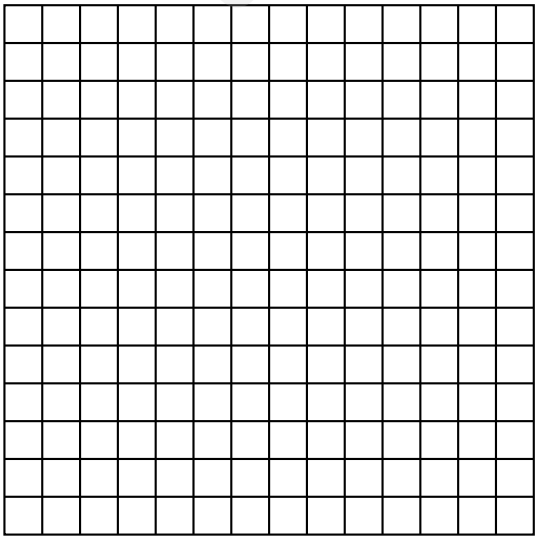
Hình 1.2



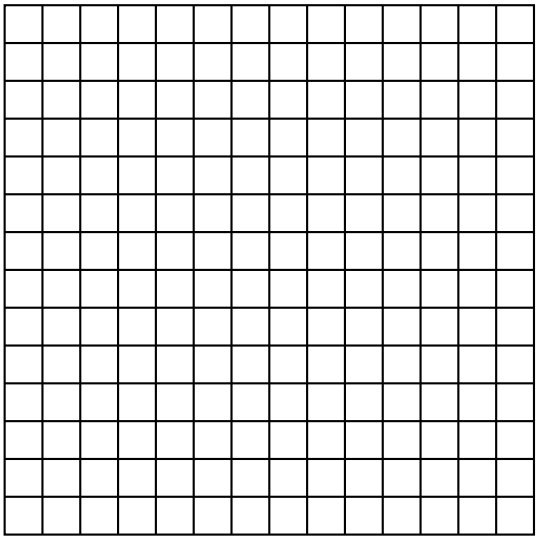
Hình I.3



Hình 1.4

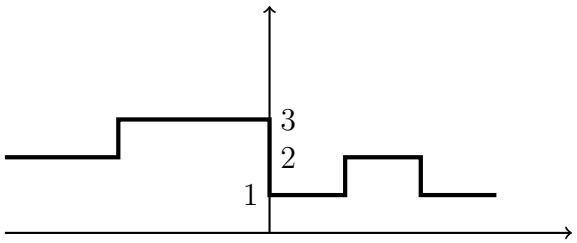


Hình I.5

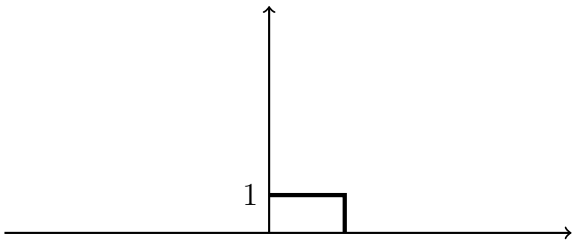


Hình 1.6

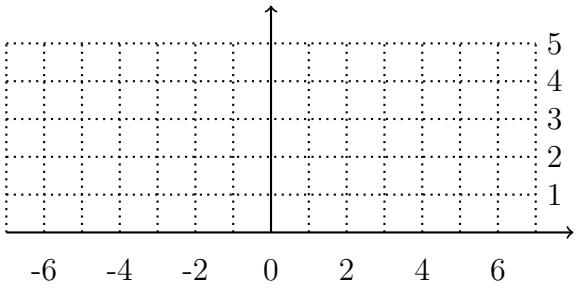
Question 2 (20 **Points**) Find the gray scale opening and closing of the function sketched in Figure II.1 with the gray scale Structural Element in Figure II.2. Sketch the intermediate and final result in Figure II.3 (Figure II.4) and Figure II.5 (Figure II.6), respectively.



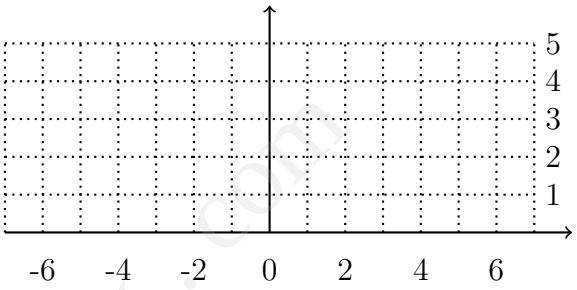
Hình II.1



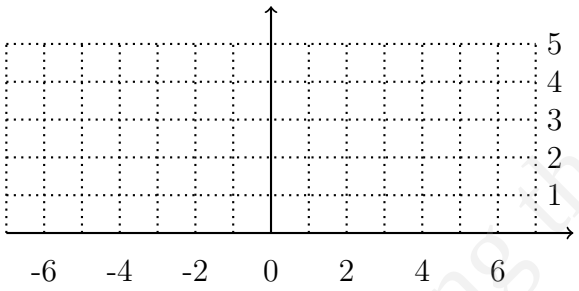
Hình II.2



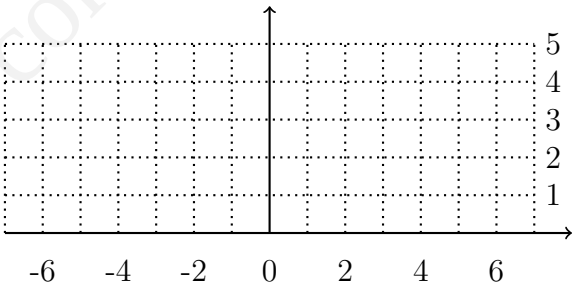
Hình II.3



Hình II.4



Hình II.5



Hình II.6

Question 3 (15 **Points**) Suppose a camera is taking pictures of an object moving with a constant speed of $v_x = 20$ m/s, $v_y = 5$ m/s, and the camera exposure time is 10^{-3} s. What is the equivalent degradation filter, both in frequency domain and in spatial domain?

Question 4 The following pattern classes have Gaussian probability density function ω_1: $\{(1,1)^T, (3,0)^T, (3,3)^T, (0,3)^T\}$, and ω_2: $\{(5,5)^T, (9,5)^T, (8,8)^T, (5,9)^T\}$. The prior probabilities are $P(\omega_1)$ and $P(\omega_2) = 1 - P(\omega_1)$.

4.1. (10 **Points**) Determine the mean vectors and the covariance matrices of these two classes.

4.2. (10 **Points**) Determine the minimum value of the prior $P(\omega_1)$ for which $x = [0,0]^T$ will be classified as ω_1?

4.3. (25 **Points**) Assume that the prior probabilities of ω_1 is $P(\omega_1) = 0.6$. Determine and sketch the boundary between these two classes using:

4.3.1. The minimum distance classifier.

4.3.2. The Bayes classifier. (Hint $A = [a \;\; b; c \;\; d]$, $\det(A) = ad - bc$, $\mathrm{A}^{-1} = [d \;\; -b, -c \;\; a]/\det(A)$) :