Mathematical Morphology And Applications
Midterm Exam

B.Math(Hons.) III Year

September 11, 2015

Instructions: Answer as much as you can. Maximum time allotted is 3 hours. The maximum you can score is 40 marks. Marks corresponding to each question is indicated in bold.

(1) Answer the following questions in the context of 2-D binary images in continuous domain:

   (a) **[3 Marks]** Tabulate the algebraic and filter properties(increasing, idempotent, extensive/anti-extensive) of Dilation, Erosion, Opening and Closing.

   (b) **[6 Marks]** From above, is Dilation extensive? If No, justify? If Yes, state the conditions under which Dilation operator is extensive?

   (c) **[6 Marks]** Is opening operator idempotent? Justify.

   (d) **[6 Marks]** Suppose T is an operator on X which is defined as the Minkowski Dilation composed with Minkowski Erosion. Is T an idempotent operator? Justify.

   (e) **[6 Marks]** Order the following operators - Dilation, Erosion, Opening, Closing, Alternating Sequential filters (ASF-Closing and ASF-Opening) and Identity. Assume that the structuring element is convex and contains the origin.

(2) **[10 Marks]** Suppose X is a compact set in $\mathbb{R}^2$. Assume a fire is lit on the border of X and propagates towards the interior of X at a constant rate in an isotropic manner. Assuming that a burnt point does not relight itself, then the locus of points of X where several fire fronts meet are called the quench points. The function that associates the time at which each point stops burning with each quench point is equivalent to the distance to the border of the set. This function is called the quench function. Explain how to reconstruct X from the quench function of X. Justify your approach.

(3) **[10 Marks]** Suppose X is a 2-D binary image consisting of several non-overlapping circles (interior included) of different sizes, in continuous domain. Give an algorithm to determine the size distribution of the circles. You do not have to consider the time and space complexities.

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