Neutrosophic Science International Association

University of New Mexico in USA

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Neutrosophic Mathematical Morphology for Medical Image

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Second International Conference

Faculty of Nursing / Port -Said University

Nursing Between Reality and Hoped

(A future vision)

21 FROM APRIL 2016

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Conference Objectives:

1- Reflect the reality of the nursing services quality and health care.

2- Monitor the negative aspects of nursing care scope, from the perspective of different groups.

3- Determine the gap between the theoretical and practical aspects of nursing.

4- Suggest multiple future visions for nursing sciences development to gain access to quality and excellence.

Conference Axes:

1- Nursing scientific research and neutrosophic logic

2- Systems of practical and theoretical evaluation of nursing students.

3- Scientific methods used to measure the quality of nursing services.

4- The reality of the theoretical and practical aspects of applied nursing.

5- Job description of the nurse between reality and expected.

6- Developmental Nursing Strategies and Programs.

7- Quality and performance excellence.

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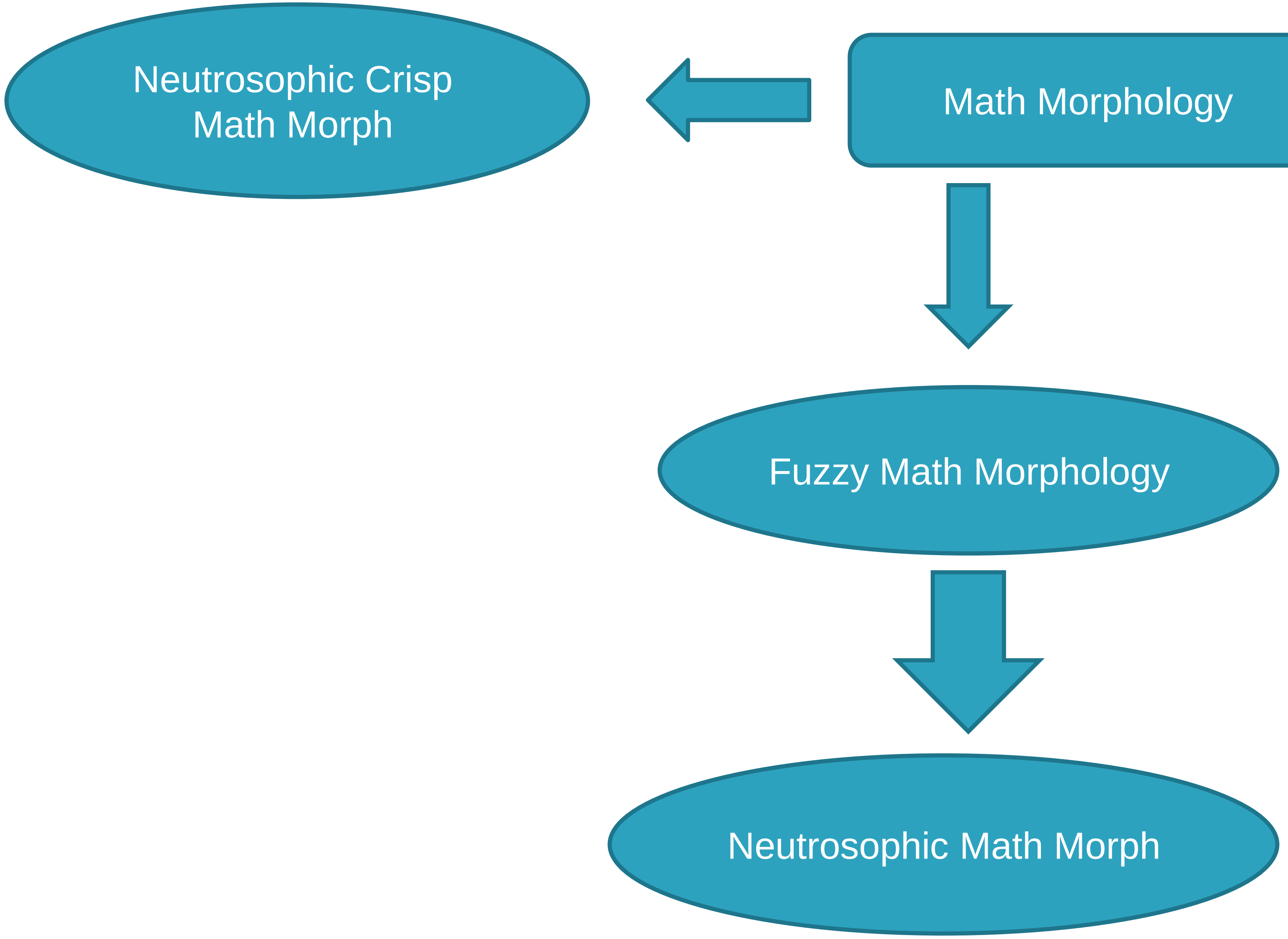
Abstract :

A new framework which extends the concepts of mathematical morphology into sets is presented . Medical Images can be considered as arrays of singletons on the Cartesian grid. Based on this notion the definitions for the basic neutrosophic morphological operations are derived. Compatibility with binary mathematical morphology as well as the algebraic properties of neutrosophic operations are studied. Explanation of the defined operations is also provided through several examples and experimental results .


Neutrosophic Crisp
Math Morph
Math Morphology
Fuzzy Math Morphology
Neutrosophic Math Morph

from the collaborative work of Georges Matheron and Jean Serra, at the École des Mines de Paris, France. Matheron supervised the PhD thesis of Serra, devoted to the quantification of mineral characteristics from thin cross sections, and this work resulted in a novel practical approach, as well as theoretical advancements in integral geometry and topology.

In 1968, the Centre de Morphologie Mathématique was founded

During the rest of the 1960s and most of the 1970s, MM dealt essentially with binary images, treated as sets, and generated a large number of binary operators and techniques: Hit-or-miss transform, dilation, erosion, opening, closing, granulometry, thinning, skeletonization...

Motivation:

Based on shapes in the image, not pixel intensities.

Morphology is the study of shape. Mathematical Morphology mostly deals with the mathematical theory of describing shapes using sets..

We can transform an image into a set of points by regarding the image's subgraph.

The subgraph of an image is defined as the set of points that lies between the graph of the image and above the image plane.

Mathematical Morphology

Is a theory and technique for the analysis and processing the geometrical structures, based on set theory, topology, and random functions.

It is most commonly applied to digital images, but it can be employed as well on graphs, surface meshes and solids..

Mathematical Morphology

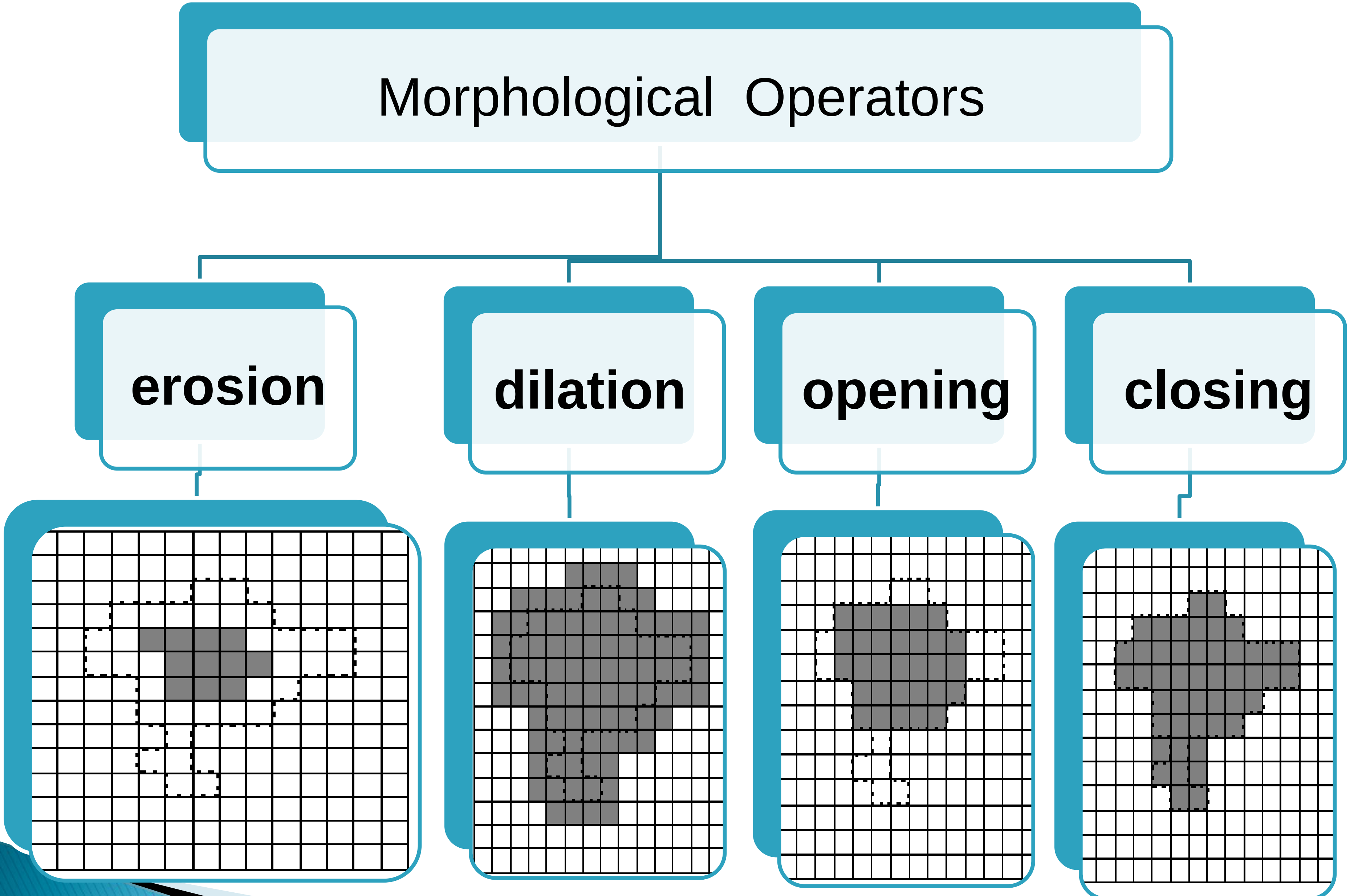
Topological and geometrical continuous -space concepts such as: **size, shape** , **convexity** **, connectivity ,** **and geodesic distance**, were introduced on both continuous and discrete spaces.

Mathematical Morphology

Mathematical Morphology is also the foundation of morphological image processing which consists of a set of operators that transform images according to those concepts.

Binary Mathematical Morphology

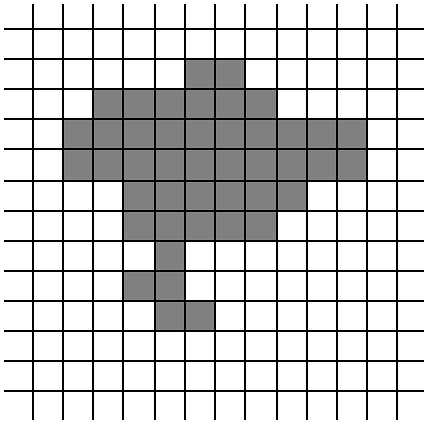
For morphology of binary images, the sets consist of pixels in an image.


Morphological Operators
erosion
dilation
opening
closing

Basic Morphological operations

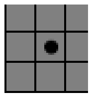
Original set, extracted as a subset

from the turbinate image



structuring element: a square of side 3.

The reference pixel is at the centre.



Binary Mathematical Morphology

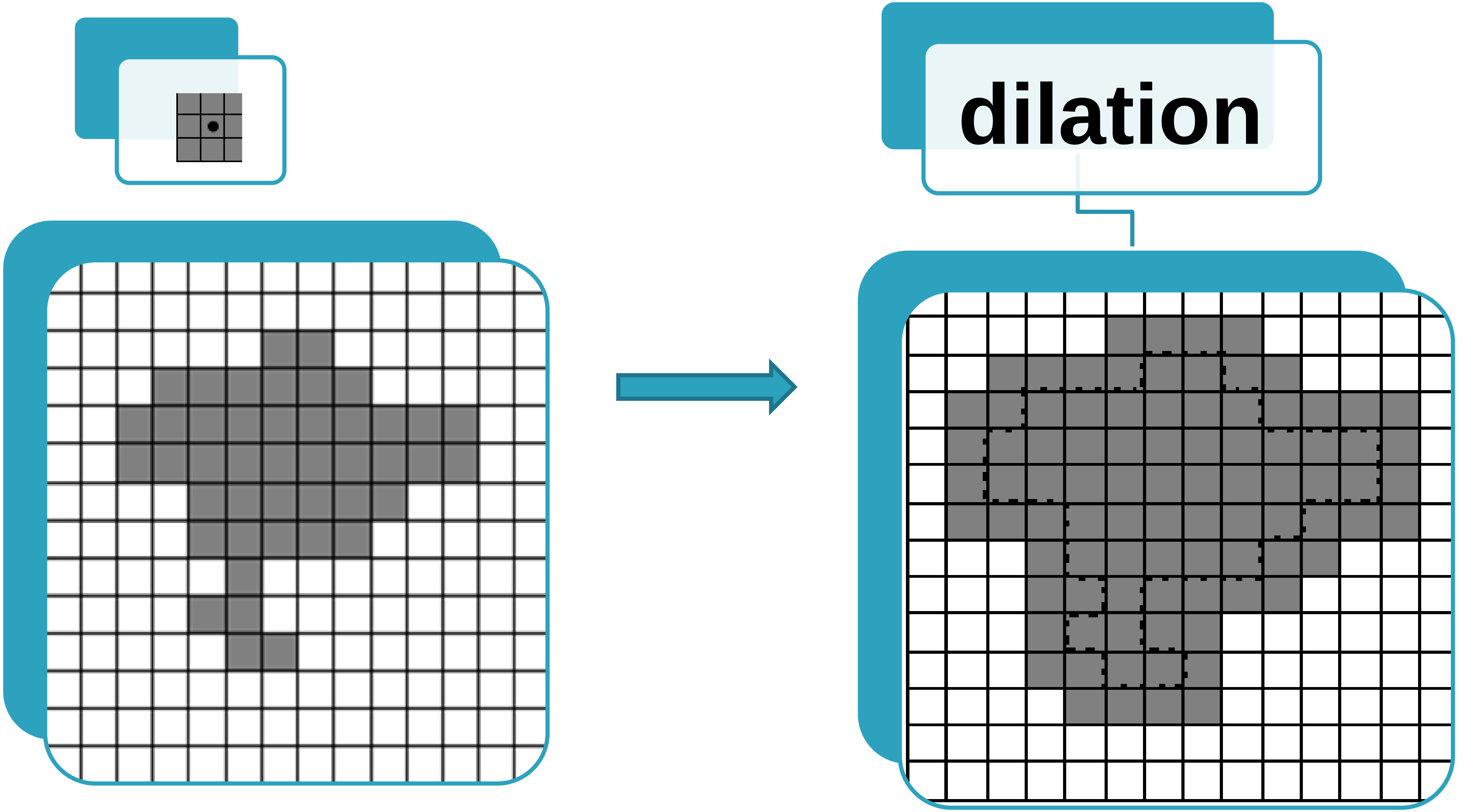
- **Dilation**

Used to increase objects in the image

$$
\begin{aligned}
X \oplus B &= \bigcup_{b \in B} X_b \ , \\
&= \bigcup_{x \in X} B_x \ , \\
&= \{x + b \mid x \in X, b \in B\}
\end{aligned}
$$

Morphological operators

dilation



Binary Mathematical Morphology

- **Erosion**

  Used to reduces objects in the image

$$X \ominus B = \bigcap_{b \in B} X_{-b} \,, \qquad = \{p \in E \mid B_p \subseteq X\} \,.$$

X^c is the complement of the set X , X^c = E \X

$$(X \oplus B)^c = X^c \ominus \breve{B} \quad , \quad (X \ominus B)^c = X^c \oplus \breve{B}$$

Morphological operators

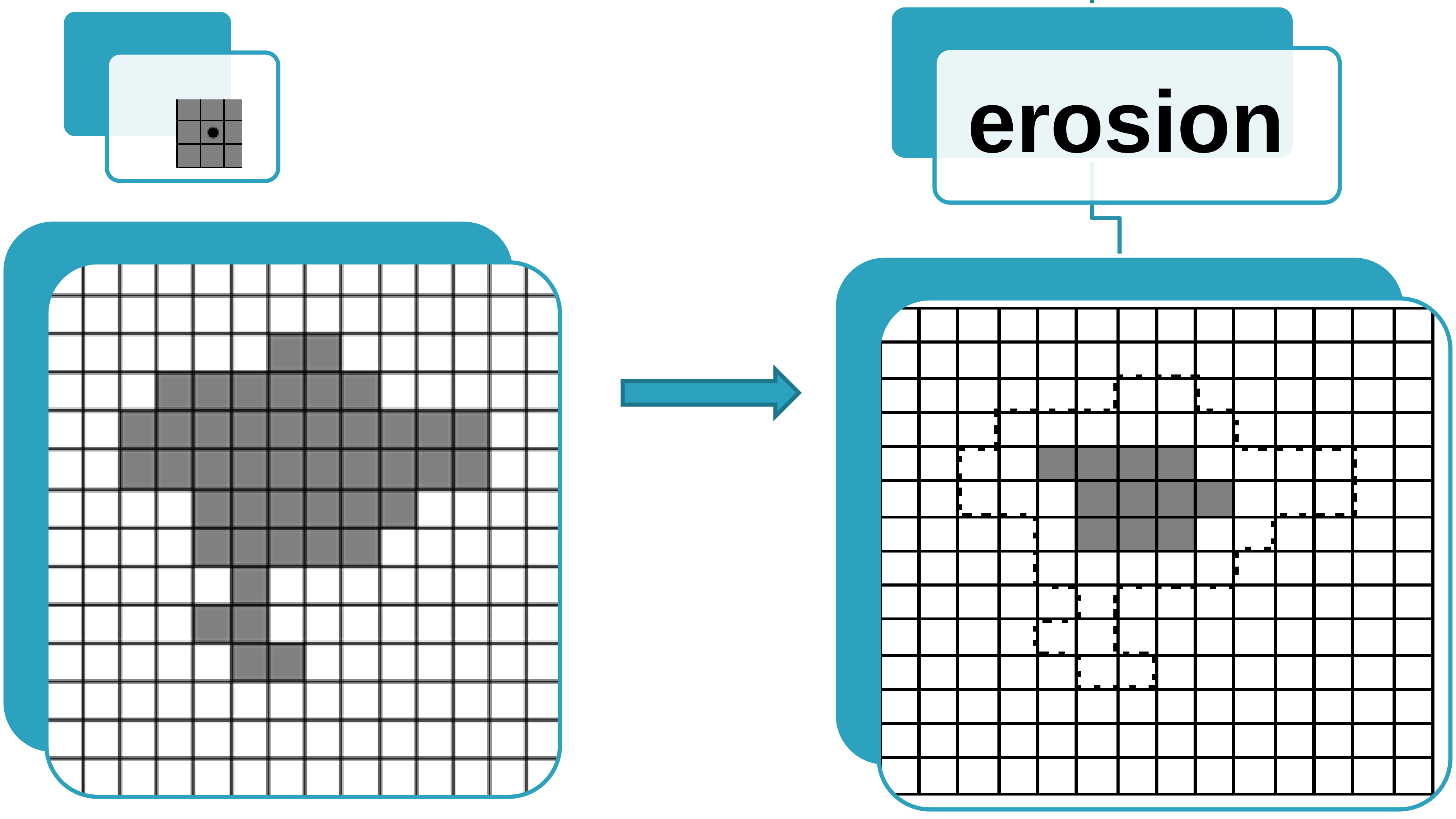


FIGURE 3.1 An example of grayscale morphological operations by a 3 × 3 square with all 0s: (a) the Lena image, (b) grayscale dilation, and (c) grayscale erosion.

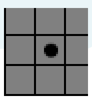
Binary Mathematical Morphology

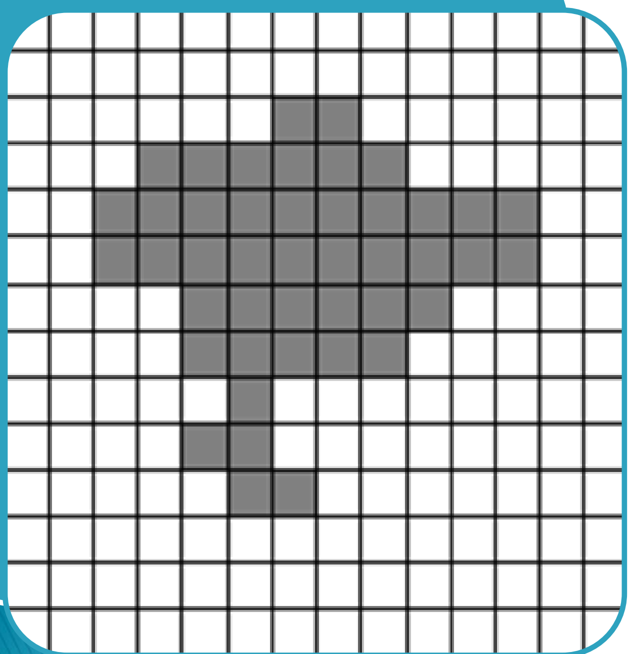
❖Opening

Used to remove unwanted structures in the image

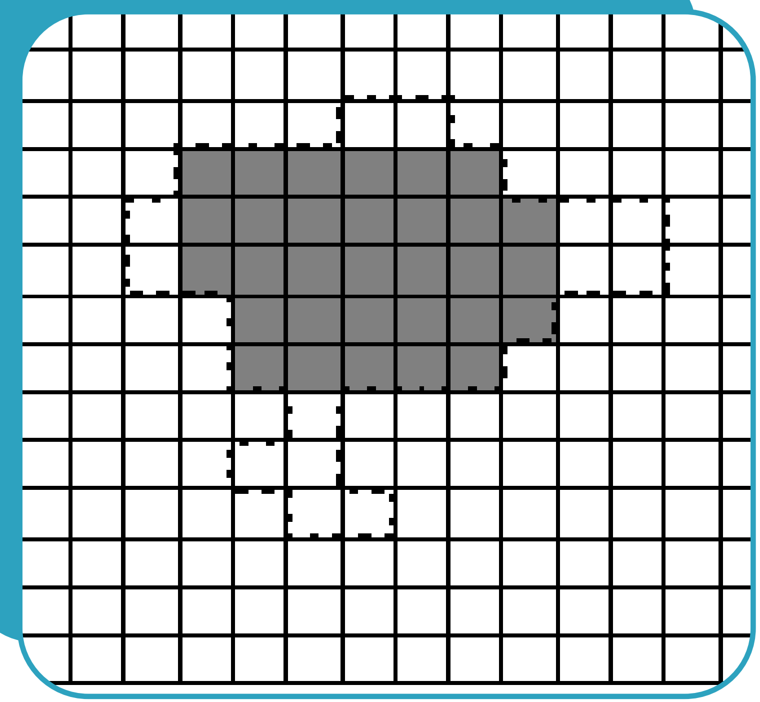
$$A \circ B \quad = \quad (A \ominus B) \oplus B$$

Morphological operators





Opening



Binary Mathematical Morphology

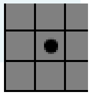
❖Closing

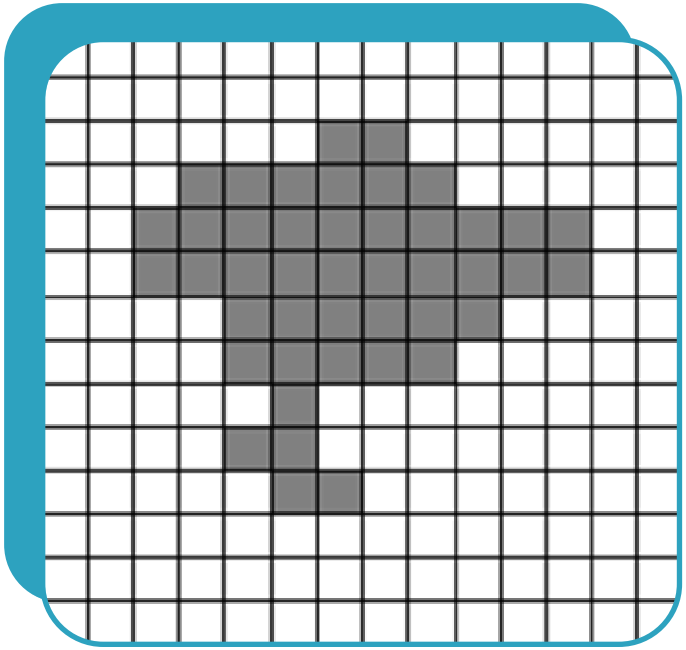
Is used to merge or fill structures in an image

$$\mathbf{A} \bullet \mathbf{B} = (\boldsymbol{A} \oplus \boldsymbol{B}) \ominus \boldsymbol{B}$$

Morphological operators

Closing





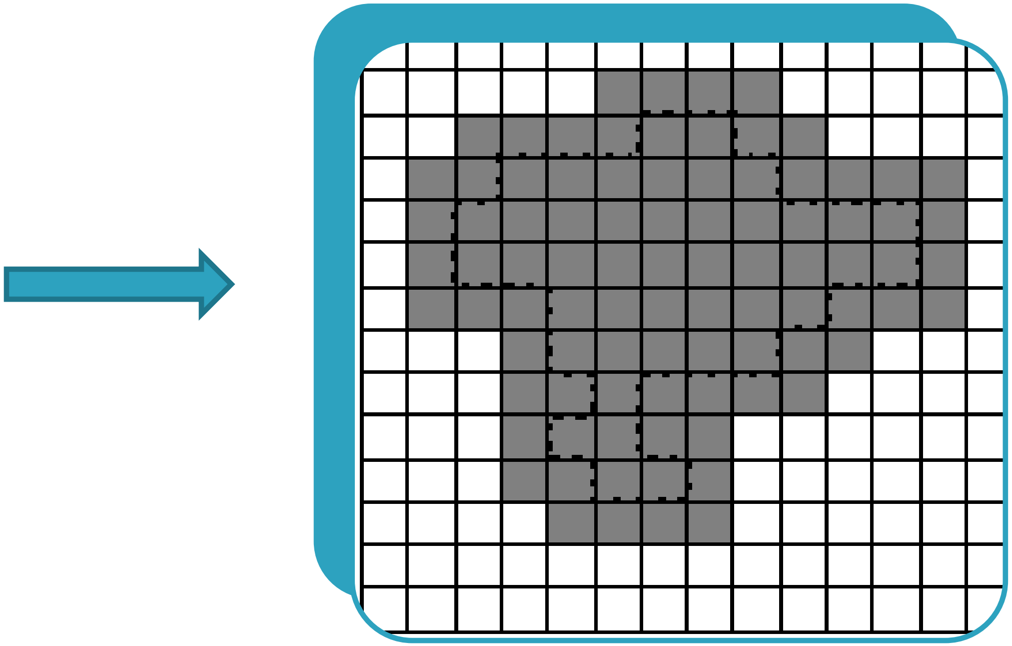


FIGURE 3.4 An example of grayscale morphological operations by a 3 × 3 square with all 0s: (a) the Lena image, (b) the grayscale opening, and (c) the grayscale closing.

FIGURE 3.5 An example of grayscale morphological operations by a 5 × 5 square with all 0s: (a) the Cameraman image, (b) the grayscale opening, and (c) the grayscale closing.

Fuzzy Mathematical Morphology

Fuzzy mathematical morphology provides an alternative extension of the binary morphological operations to gray-scale images based on the theory of fuzzy set .

Fuzzy Mathematical Morphology

The operation of intersection and union used in **binary** mathematical morphology are replaced by **minimum** and **maximum** operation respectively .

Fuzzy Mathematical Morphology

❖ dilation

Let us consider the notion of dilation within the original formulation of mathematical morphology in Euclidean space E. For any two n-dimensional gray-scale images, A and B, the fuzzy dilation,

$A \oplus B = \langle \mu_{A \oplus B} \rangle$, of A by the structuring element B is an n-dimensional gray-scale image, that is: $\mu_{A \oplus B} : Z^2 \longrightarrow [0,1]$, and

$$\mu_{A \oplus B}(v) = \sup_{u \in Z^2} \min\left[\mu_A(v + u)\ ,\ \mu_B(u)\right]$$

Fuzzy Mathematical Morphology

❖ erosion

For any two n-dimensional gray-scale image, A and B, the fuzzy erosion $A \ominus B = \langle \mu_{A \ominus B} \rangle$ of A by the structuring element B is an n-dimensional gray-scale image, that is: $\mu_{A \ominus B} : Z^2 \longrightarrow [0,1]$, and

$$\mu_{A \ominus B}(v) = \inf_{u \in Z^2} \max\left[\mu_A(v+u), 1 - \mu_B(u)\right]$$

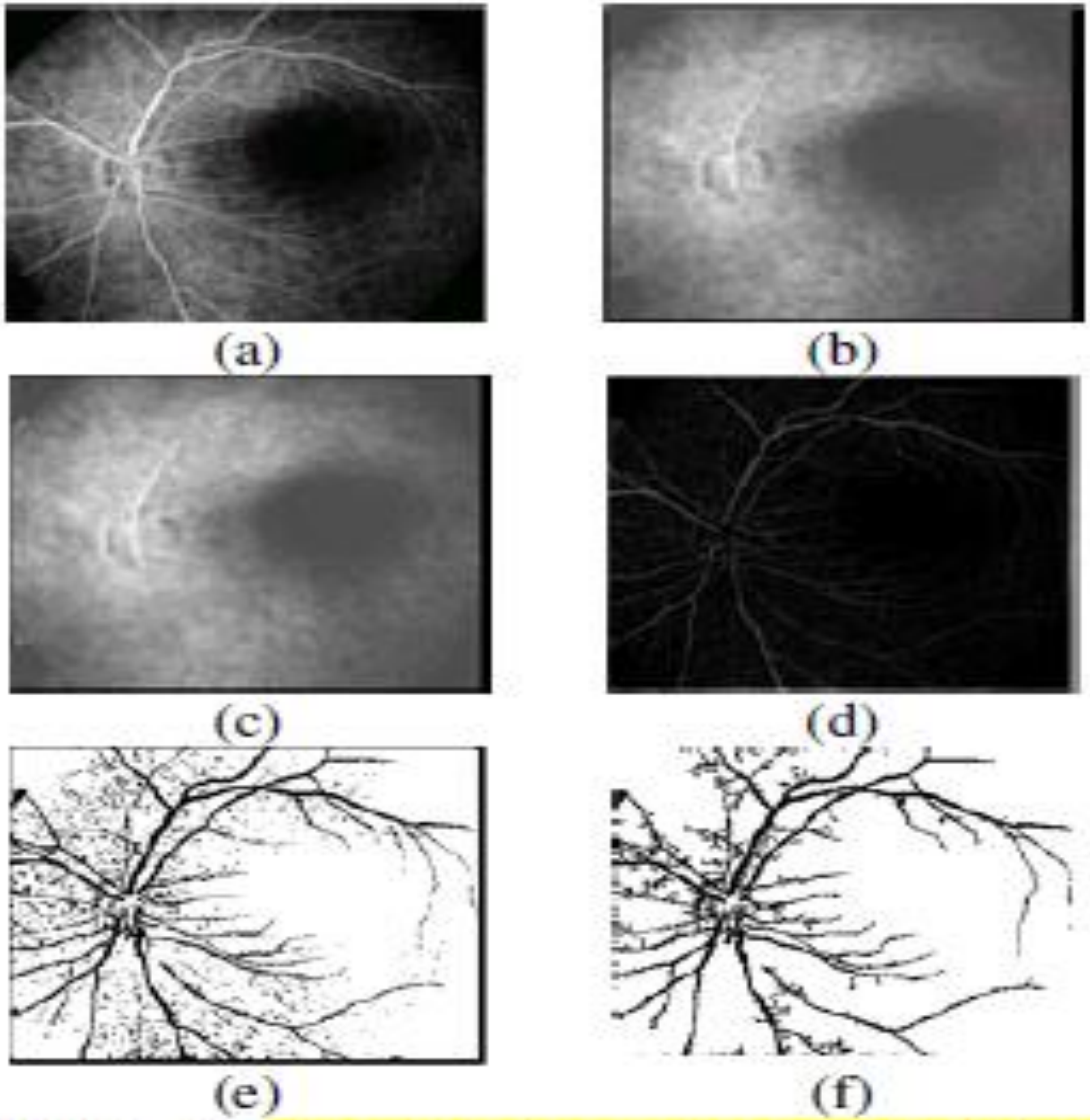
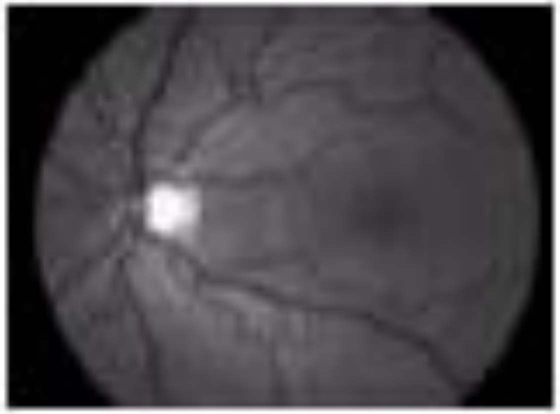


Figure 6: (a) Original Image; (b) Fuzzy Erosion; (c) Fuzzy Dilation; (d) Fuzzy Top-Hat; (e) Binarization; (f) Final Image.

(a)Original Image



(a)

(c)

(b)

(c) Fuzzy Dilation

(b) Fuzzy Erosion

Neutrosophic Mathematical Morphology

In this thesis we aim to use the concepts from Neutrosophic (both crisp and fuzzy) set theory to Mathematical Morphology which will allow us to deal with not only grayscale images but also the colored images.

Neutrosophic Mathematical Morphology

The introduction of neutrosopic morphology is based on the fact that the basic morphological operators make use of fuzzy set operators, or equivalently, crisp logical operators. Such expressions can easily be extended to the context of neutrosophic sets. In the binary case, where the image and the structuring element are represented as crisp subsets of Rn.

Algebraic properties in Neutrosophic

mathematical morphology

The algebraic properties for neutrosophic erosion and dilation, as well as for neutrosophic opening and closing operations are now considered.

Duality theorem:

Neutrosophic erosion and dilation are dual operations i.e.

$$\mu_{A^c \oplus B}(x) = \mu_{(A \ominus B)^c}(x)$$

$$\sigma_{A^c \oplus [-B]}(x) = \sigma_{(A \ominus B)^c}(x)$$

$$\gamma_{A^c \oplus [-B]}(x) = \gamma_{(A \ominus B)^c}(x)$$

Neutrosophic opening is defined by the flowing:

$$\mu_{A\circ B}(x) = \mu_{(A\ominus B)\oplus B}(x)$$
$$\sigma_{A\circ B}(x) = \sigma_{(A\ominus B)\oplus B}(x)$$
$$\gamma_{A\circ B}(x) = \gamma_{((A\ominus B)\oplus B)^c}(x)$$

Neutrosophic Closing is defined by the flowing:

$$\mu_{A\bullet B}(x) = \mu_{(A\oplus B)\ominus B}(x)$$
$$\sigma_{A\bullet B}(x) = \sigma_{(A\oplus B)\ominus B}(x)$$
$$\gamma_{A\bullet B}(x) = \gamma_{((A\oplus B)\ominus B)^c}(x)$$

Thank You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Nursing researche
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