University of Al-Hamdaniya
Computer Science Department
Digital image processing

Mathematical and Logical Operations on a Digital Image

Lec-14

By

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Mathematical Operations on a Digital Image

1) **Addition :** is used to combine the information in two images. Applications include development of image restoration algorithm for molding additive noise, and special effects, such as image morphing in motion pictures.

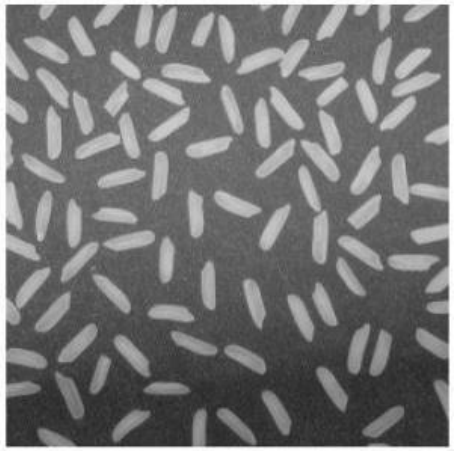


Image - 1

+

Image - 2

=

Image - 3

Mathematical Operations on a Digital Image

Since the colors have a value ranging from (0 255), there is a problem when adding two values and the result is more than 255, so it works to cut the colors to 255 because the type of image 8-bits, which leads to the loss of some colors, so it is preferable to expand the color field from (0-512), i.e. converting the image type into a 16-bits type

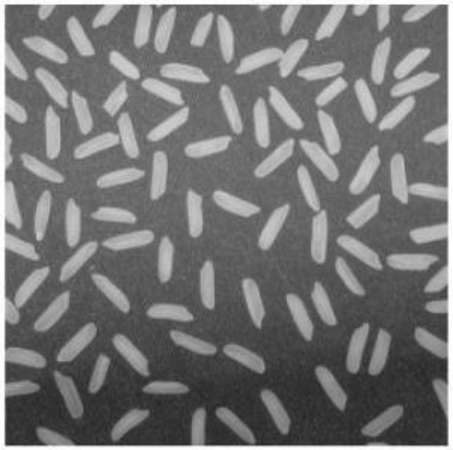


Image - 1

+

Image - 2

=

Image - 3

Mathematical Operations on a Digital Image

Also, a fixed number can be added to the image for the purpose of **lightening** the image

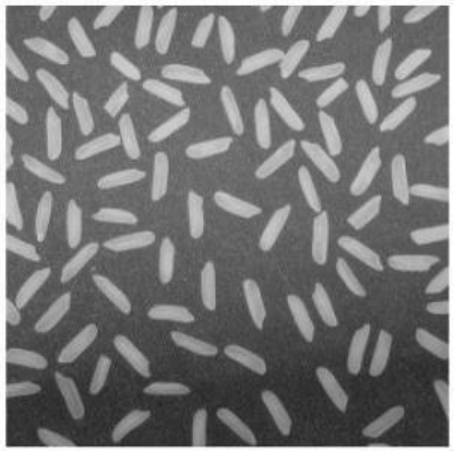
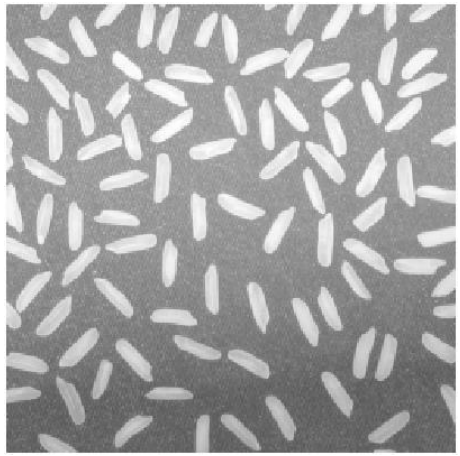


Image - 1

+ **50** =



Add image to constant

Mathematical Operations on a Digital Image

2) **Subtraction:** of two images is often used to detect motion, consider the case where nothing has changed in a sense ;the image resulting from subtraction of two sequential image is filled with zero-a black image .If something has moved in the scene, subtraction produces a nonzero result at the location of movement. Applications include Object tracking, Medical imaging, Law enforcement and Military applications.

Original scene

Same scene later

Subtraction of scene a from scene

Mathematical Operations on a Digital Image

3,4) Multiplication and Division are used **to adjust the brightness of an image** .One image typically consists of a constant number greater than one. Multiplication of the pixel values by a number greater than one will darken the image (Brightness adjustment is often used as a processing step in image enhancement)

Image - 1

* **0.5** =

Image - 3

Image - 1

/ **0.5** =

Image - 3

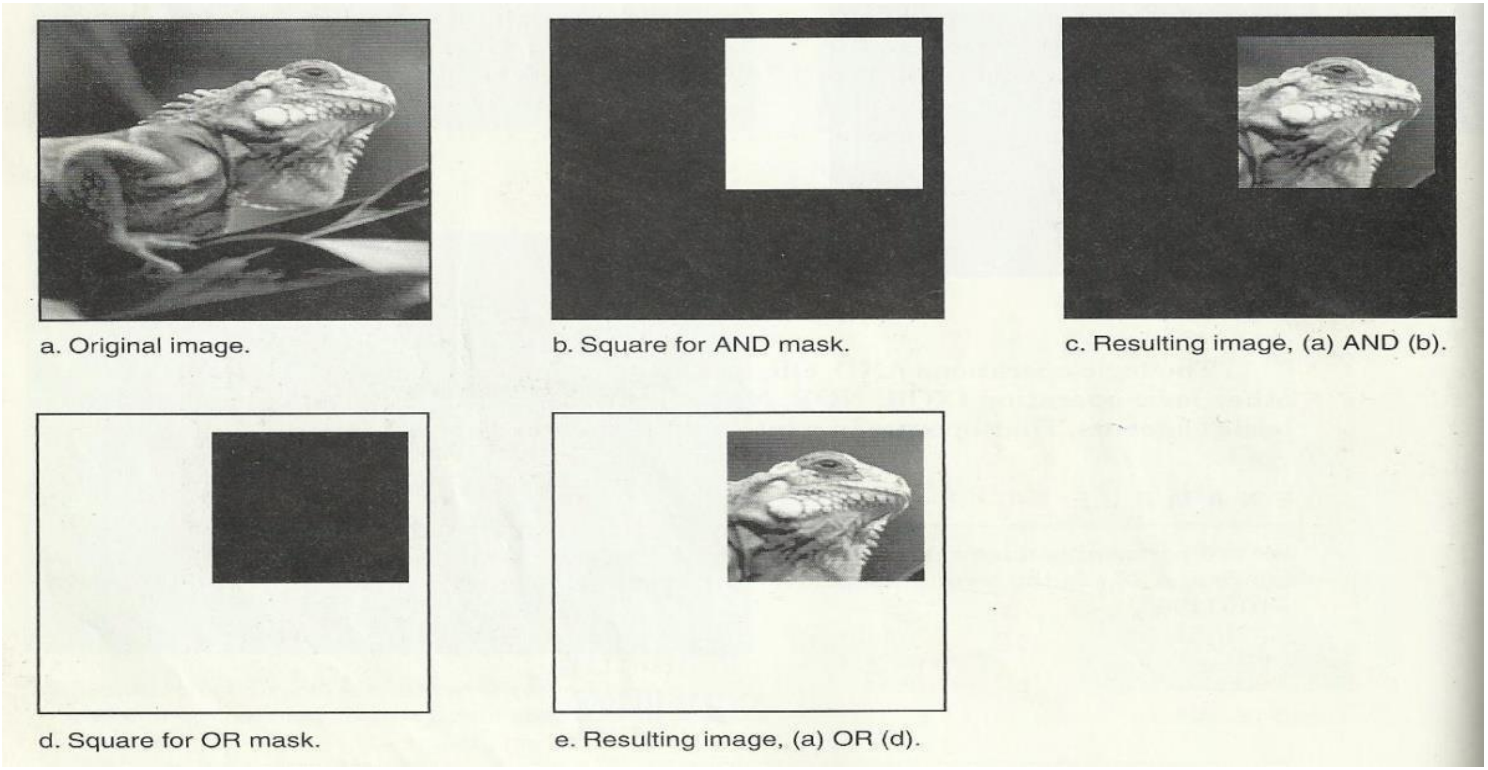
Logical Operations on a Digital Image

Logical operations : apply only to binary images ,whereas arithmetic operations apply to multi-valued pixels. Logical operations are basic tools in binary image processing, where they are used for tasks such as **masking, feature detection ,and shape analysis** .Logical operations on entire image are performed pixel–by–pixel .

	AND				OR				XOR			
input1	1	1	0	0	1	1	0	0	1	1	0	0
Input2	1	0	1	0	1	0	1	0	1	0	1	0
output	1	0	0	0	1	1	1	0	0	1	1	0

Logical **AND & OR** operations are useful for the **masking** and **compositing** of images. For example ,if we compute the AND of a binary image with some other image, then pixels for which the corresponding value in the binary image is **1** will be **preserved**, but pixels for which the corresponding binary value is **0** will be set to **0(erased)**.Thus the binary image acts as a“ mask ”that removes information from certain parts of the image.

Logical operations on a digital image

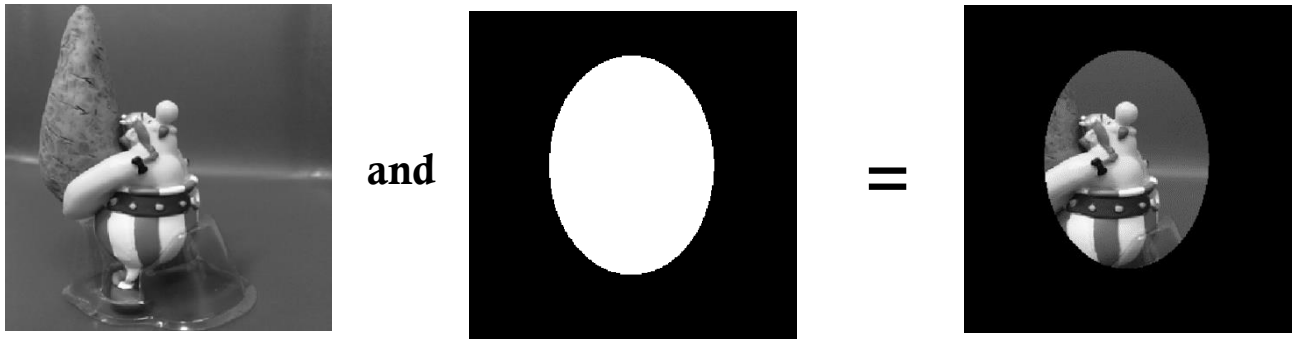


On the other hand ,if we compute the **OR** of a binary image with some other image, the pixels for which the corresponding value in the binary image is **0** will be **preserved** ,but pixels for which the corresponding binary value is **1**, will be set to **1** (**cleared**.) So ,masking is a simple method to extract a region of interest (ROI) from an image

Logical operations on a digital image

1. AND operation

This operation can be used to find the **similarity** white regions of two different images (it required two images)



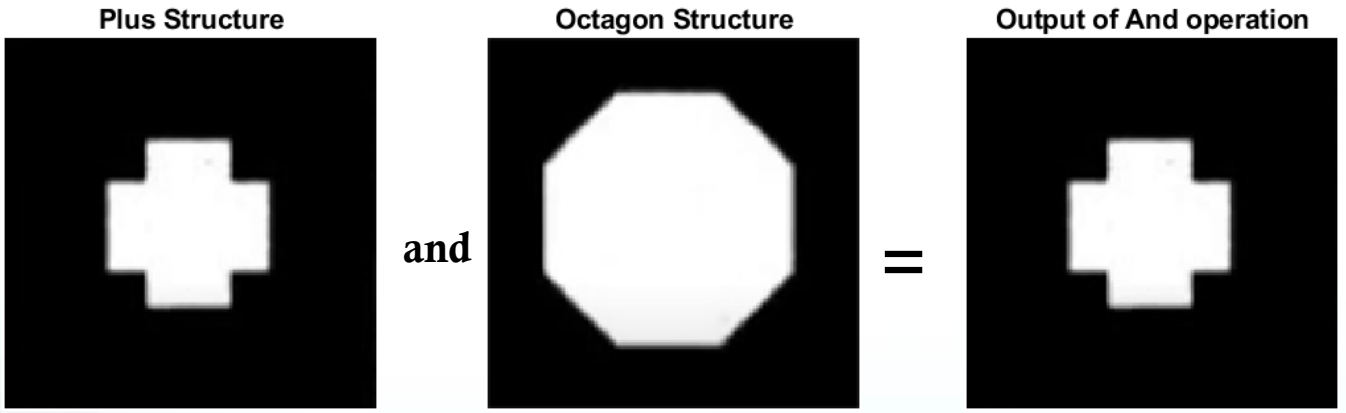
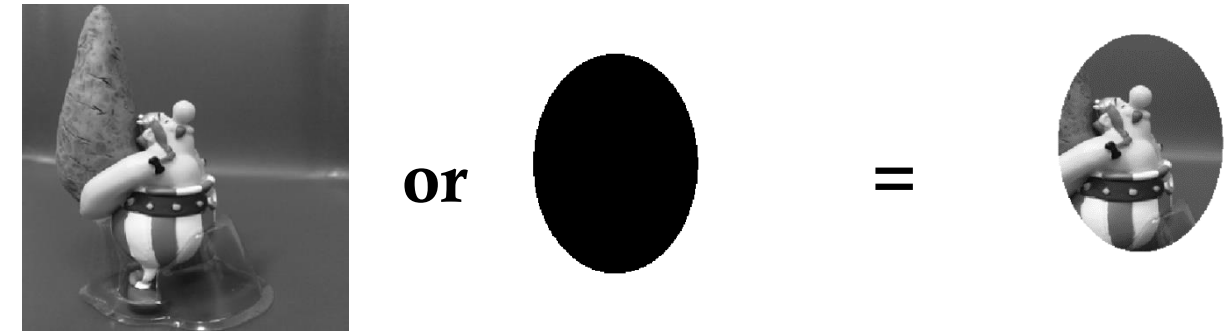


Image - 1 Image - 2 Image - 3

Logical operations on a digital image

2. OR operation



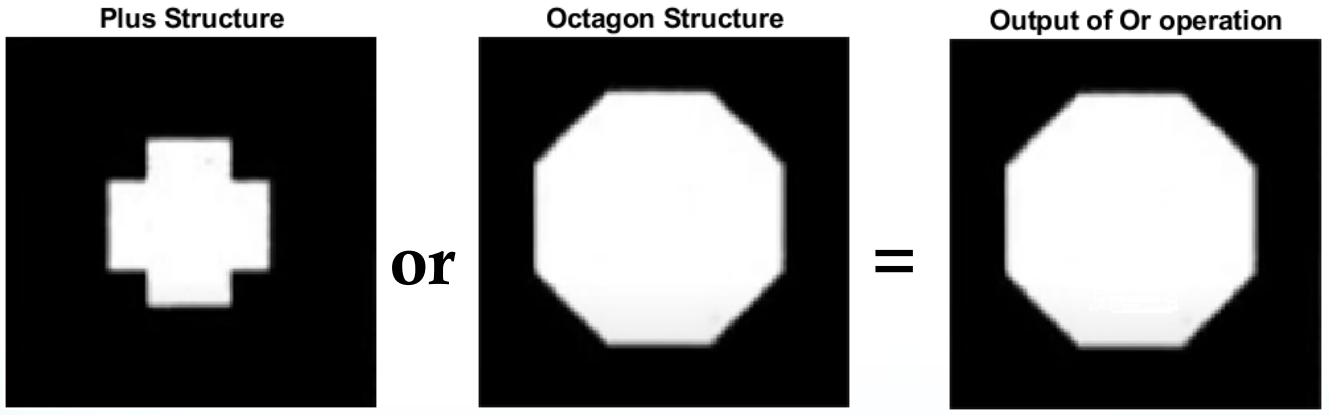
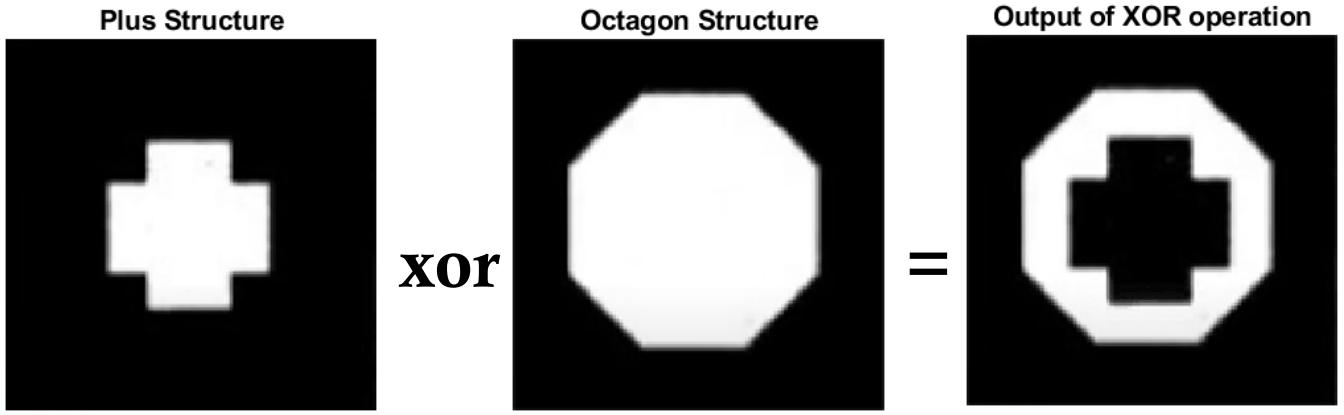


Image - 1 Image - 2 Image - 3

Logical operations on a digital image

3. XOR operation

This operator can be used **to find the differences between white regions** of two different images (it requires two images).

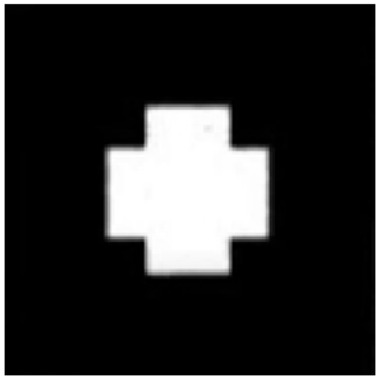


Logical operations on a digital image

4. Not operation

Not =

Plus Structure



Not =

Output of Not operation

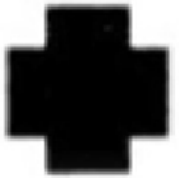


Image - 1

Image - 2

End of Lecture