Computer Engineering Department
Faculty of Engineering
Cairo University
Image Processing & Computer Vision - CMP(N)446

Tutorial 8

Texture Analysis

Quiz Time

Algorithms Review

GLCM & LBP

Gray Level Co-occurrence Matrix

Goal

- Get a quantitative measure of the texture present in an image (statistical texture analysis approach)

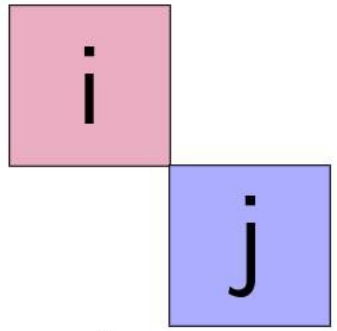
Algorithm of GLCM:

Image

0	1	2	1
0	0	0	2
2	1	1	2
1	1	2	1

Algorithm of GLCM:

Relationship



Image

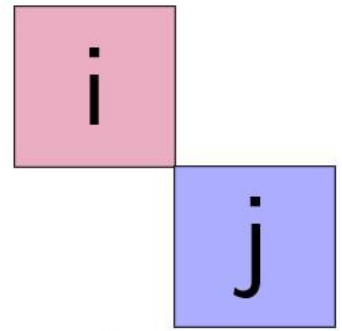
0	1	2	1
0	0	0	2
2	1	1	2
1	1	2	1

Algorithm of GLCM:

GLCM

i \ j	0	1	2
0	-	-	-
1	-	-	-
2	-	-	-

Relationship



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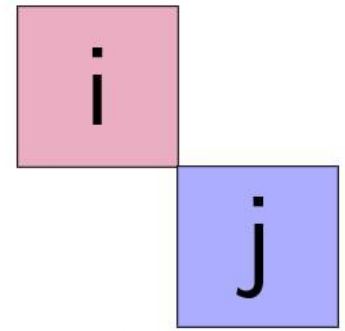
0	0	0	2
2	1	1	2
1	1	2	1

Algorithm of GLCM:

GLCM

i \ j	0	1	2
0	0	0	0
1	0	0	0
2	0	0	0

Relationship



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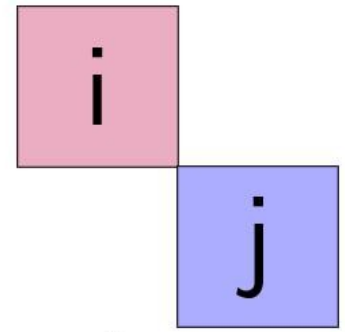
Algorithm of GLCM:

GLCM

i \ j	0	1	2
0	0	0	0
1	0	0	0
2	0	0	0

Relationship



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0	1	0	0
1	0	0	0
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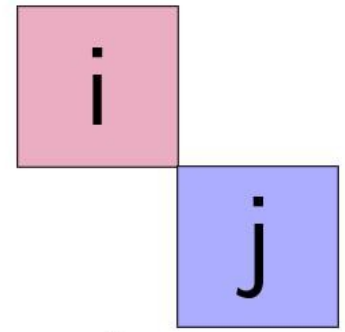
Relationship



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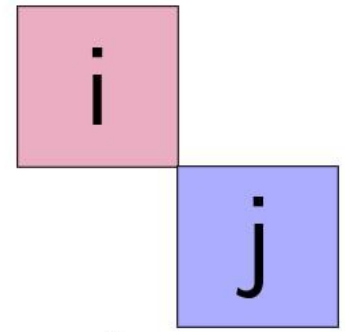

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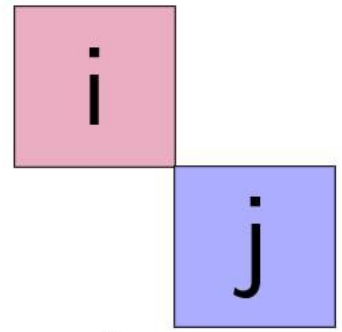
Relationship



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Algorithm of GLCM:

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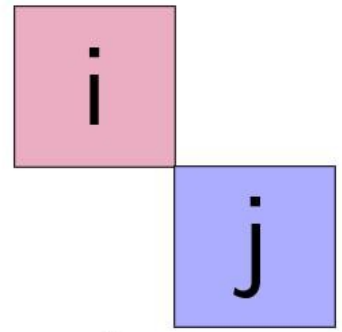
0	1	0	0
1	1	0	0
2	0	0	0

Relationship



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Algorithm of GLCM:

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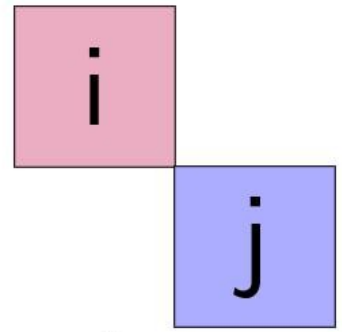
Relationship



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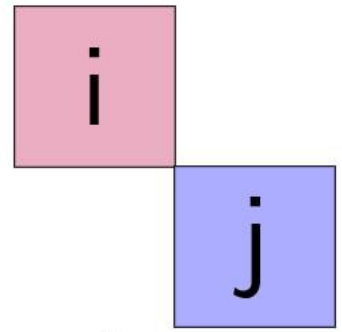

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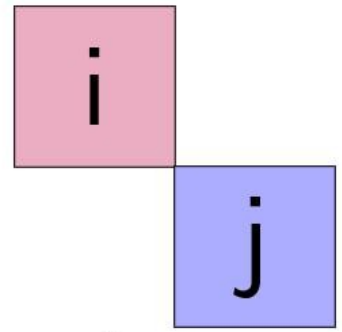

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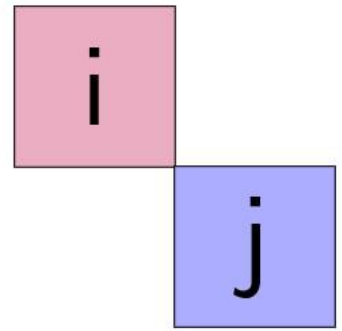
2	1	1	2
1	1	2	1

GLCM

i \ j	0	1	2
0	1	1	0
1	1	0	0
2	0	0	1

Relationship



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GLCM

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0	1	2	0
1	1	0	0
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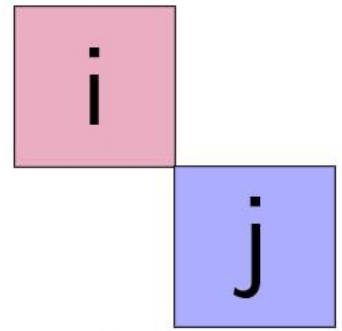

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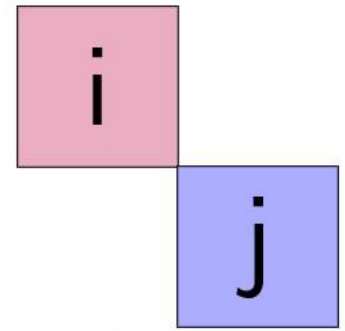

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Converting GLCM to a Compact Representation

Since the matrix is often huge and sparse, it is further processed to get a more compact measure (like homogeneity).

$$Energy = \sum_i \sum_j N_d^2(i,j) \tag{7.7}$$

$$Entropy = -\sum_i \sum_j N_d(i,j) log_2 N_d(i,j) \tag{7.8}$$

$$Contrast = \sum_i \sum_j (i-j)^2 N_d(i,j) \tag{7.9}$$

$$Homogeneity = \sum_i \sum_j \frac{N_d(i,j)}{1+|i-j|} \tag{7.10}$$

$$Correlation = \frac{\sum_i \sum_j (i-\mu_i)(j-\mu_j) N_d(i,j)}{\sigma_i \sigma_j} \tag{7.11}$$

where μ_i, μ_j are the means and σ_i, σ_j are the standard deviations of the row and column

Local Binary Pattern

LBP Algorithm

- For each pixel, we will create an 8-bit number that represents its relationship to its neighbors.
- Then, we will make a histogram from the output 2D matrix.

Lab Time