EE 146: Computer Vision

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Lab 9: Texture Descriptors

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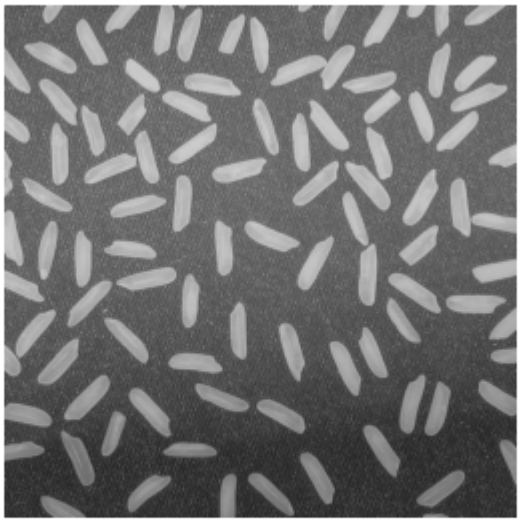
Goal: Understand co-occurrence matrices as a characteristic of texture in images.

Problem 1: Co-occurrence matrices and features

A co-occurrence matrix is a two-dimensional array C in which both the rows and the columns represent a set of possible image values V. Co-occurrence matrix **C(i, j)** indicates how many times gray scale value **i** co-occurs with gray scale value **j** in some designated spatial relationship d. d is a displacement vector **(dr, dc)** where **dr** is a displacement in rows and **dc** is a displacement in columns.

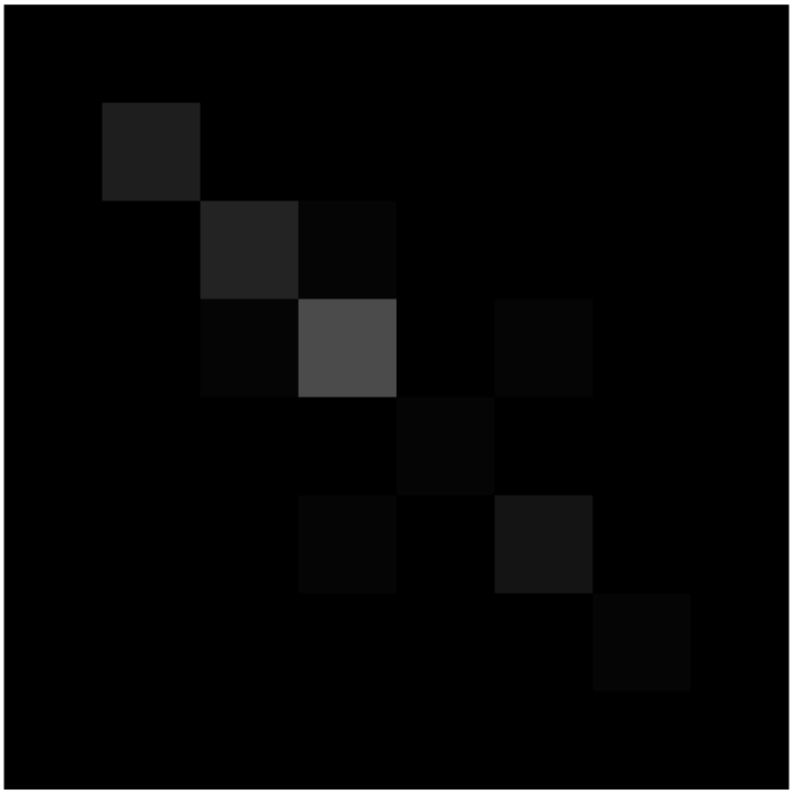
```
% Get image
I = imread('rice.png');
imshow(I)
```



```
% Compute co-occurence Matrix D(1,2)
glcm1 = graycomatrix(I,'Offset',[1 2])
```

```
glcm1 = 8×8
           0           0           0           0           0           0 ···
           0        7764        1053         171         127           0
           0        1206        9251        2266         488         196
           0         189        2303       19130        1150        1839
           0         164         480        1129        2189         767
           0           0         289        1809         815        6014
           0           0           0         310         136         899
           0           0           0           0           0           0
```

```
% Normalize the matrix
total = 0;
total_entropy1 = 0;
for i = 1:size(glcm1,1)
    for j = 1:size(glcm1,2)
        value = glcm1(i,j);
        total = total+value;
    end
end
glcm1_1 = glcm1/total;
imshow(glcm1_1, "InitialMagnification", 5000)
```



```
% Compute energy
```

```
            energy1 = graycoprops(glcm1, 'Energy')
```

```
energy1 = struct with fields:
    Energy: 0.1384
```

```
        % Compute entropy
            for i = 1:size(glcm1_1,1)
                for j = 1:size(glcm1_1,2)
                    value = glcm1_1(i,j);
                    if value ~= 0
                        entropy = -value*log(value);
                        total_entropy1 = total_entropy1 + entropy;
                    end
                end
            end
            total_entropy1
```

```
total_entropy1 = 2.5032
```

```
        % Compute contrast
            contrast1 = graycoprops(glcm1, 'Contrast')
```

```
contrast1 = struct with fields:
    Contrast: 0.7025
```

```
        % Compute correlation
            correlation1 = graycoprops(glcm1, 'Correlation')
```

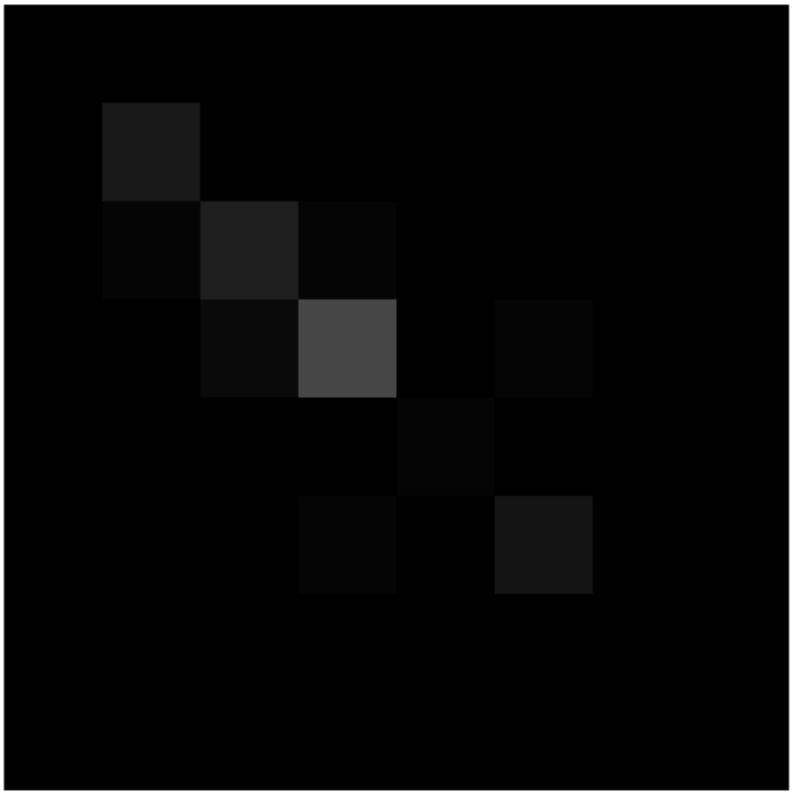
```
correlation1 = struct with fields:
    Correlation: 0.8075
```

```
% Compute co-occurence Matrix D(2,2)
glcm2 = graycomatrix(I,'Offset',[2 2])
```

```
glcm2 = 8×8
           0           0           0           0           0           0 ···
           0        7470        1072         215         155           0
           0        1399        8633        2445         624         290
           0         228        2640       18238        1138        2214
           0         226         589        1131        2000         743
           0           0         393        2209         829        5479
           0           0           0         454         148         928
           0           0           0           0           0           0
```

```
    % Normalize the matrix
    total = 0;
    total_entropy2 = 0;
    for i = 1:size(glcm2,1)
        for j = 1:size(glcm2,2)
            value = glcm2(i,j);
            total = total+value;
        end
```

```
    end
    glcm2_2 = glcm2/total;
    imshow(glcm2_2, "InitialMagnification", 5000)
```



```
        % Compute energy
            energy2 = graycoprops(glcm2, 'Energy')
```

```
energy2 = struct with fields:
    Energy: 0.1276
```

```
        % Compute entropy
            for i = 1:size(glcm2_2,1)
                for j = 1:size(glcm2_2,2)
                    value = glcm2_2(i,j);
                    if value ~= 0
                        entropy = -value*log(value);
                        total_entropy2 = total_entropy2 + entropy;
                    end
                end
            end
            total_entropy2
```

```
total_entropy2 = 2.5846
```

```
        % Compute contrast
            contrast2 = graycoprops(glcm2, 'Contrast')
```

```
contrast2 = struct with fields:
    Contrast: 0.8668
```

```
        % Compute correlation
            correlation2 = graycoprops(glcm2, 'Correlation')
```

```
correlation2 = struct with fields:
    Correlation: 0.7622
```

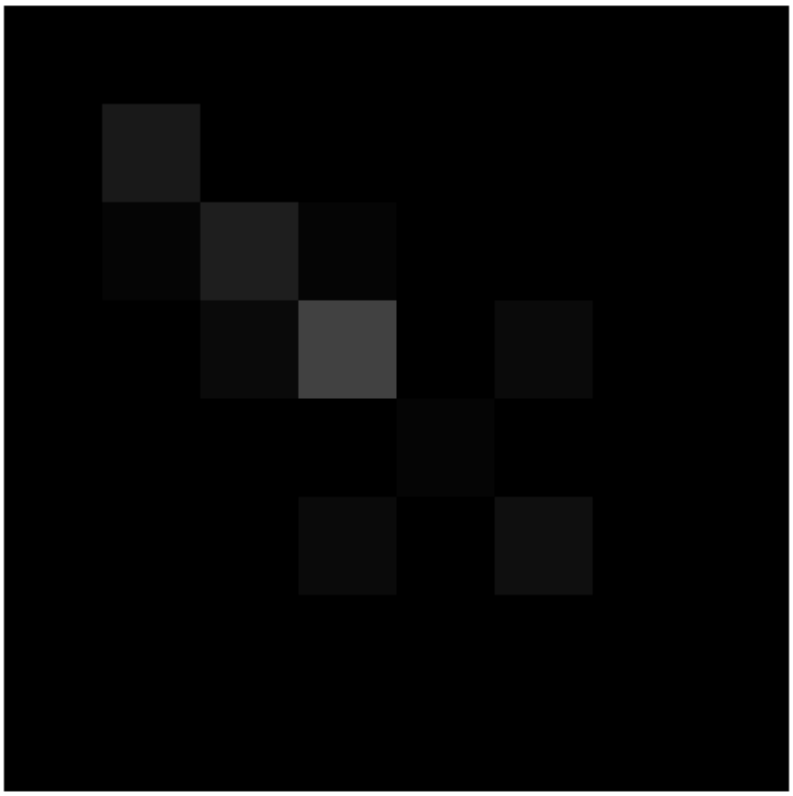
```
% Compute co-occurence Matrix D(2,3)
glcm3 = graycomatrix(I,'Offset',[2 3])
```

```
glcm3 = 8×8
           0           0           0           0           0           0 ···
           0        7284        1033         279         285           0
           0        1382        8427        2301         736         497
           0         280        2511       17341        1145        2843
           0         349         717        1134        1721         704
           0           0         585        2898         798        4611
           0           0           4         671         179         937
           0           0           0           0           0           0
```

```
    % Normalize the matrix
    total = 0;
    total_entropy3 = 0;
    for i = 1:size(glcm3,1)
        for j = 1:size(glcm3,2)
            value = glcm3(i,j);
            total = total+value;
        end
    end
    glcm3_3 = glcm3/total
```

```
glcm3_3 = 8×8
         0         0         0         0         0         0         0         0
         0    0.1133    0.0161    0.0043    0.0044         0         0         0
         0    0.0215    0.1311    0.0358    0.0115    0.0077    0.0000         0
         0    0.0044    0.0391    0.2698    0.0178    0.0442    0.0095         0
         0    0.0054    0.0112    0.0176    0.0268    0.0110    0.0031         0
         0         0    0.0091    0.0451    0.0124    0.0718    0.0144         0
         0         0    0.0001    0.0104    0.0028    0.0146    0.0136         0
         0         0         0         0         0         0         0         0
```

```
    imshow(glcm3_3, "InitialMagnification", 5000)
```



```
        % Compute energy
            energy3 = graycoprops(glcm3, 'Energy')
```

```
energy3 = struct with fields:
    Energy: 0.1185
```

```
        % Compute entropy
            for i = 1:size(glcm3_3,1)
                for j = 1:size(glcm3_3,2)
                    value = glcm3_3(i,j);
                    if value ~= 0
                        entropy = -value*log(value);
                        total_entropy3 = total_entropy3 + entropy;
                    end
                end
            end
            total_entropy3
```

```
total_entropy3 = 2.6617
```

```
        % Compute contrast
```

```
contrast3 = graycoprops(glcm3, 'Contrast')
```

```
contrast3 = struct with fields:
    Contrast: 1.1274
```

```
% Compute correlation
correlation3 = graycoprops(glcm3, 'Correlation')
```

```
correlation3 = struct with fields:
    Correlation: 0.6907
```