CE-712: Digital Image Processing of Remotely Sensed Data

Laboratory Exercise #

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Five matrices a, b, c, d and e with their corresponding mean a_mean, b_mean, c_mean, d_mean and e_mean found using function `mean()`

```
>> a = ([1 2 3; 4 5 6; 7 8 9])

a =

     1     2     3
     4     5     6
     7     8     9
```

```
>> a_mean = mean(a(:))

a_mean =

     5
```

```
>> b = a.*2

b =

     2     4     6
     8    10    12
    14    16    18
```

```
>> b_mean = mean(b(:))

b_mean =

    10
```

```
>> c = a+3

c =

     4     5     6
     7     8     9
    10    11    12
```

```
>> c_mean = mean(c(:))

c_mean =

     8
```

```
>> d = rand(3,3).*10

d =

    8.1472    9.1338    2.7850
    9.0579    6.3236    5.4688
    1.2699    0.9754    9.5751
```

```
>> d_mean = mean(d(:))

d_mean =

    5.8596
```

```
>> e = rand(3,3).*10

e =

    9.6489    9.5717    1.4189
    1.5761    4.8538    4.2176
    9.7059    8.0028    9.1574
```

```
>> e_mean = mean(e(:))

e_mean =

    6.4614
```

Method of finding correlation of all the matrices

1. Concatenating the 5 matrices into single matrix “all_array” such that arrays are represented by columns. For e.g. column 1 represents array a , column 2 represents array b and so on.

```
>> all_array = cat(2,a(:),b(:),c(:),d(:),e(:))

all_array =

    1.0000    2.0000    4.0000    8.1472    9.6489
    4.0000    8.0000    7.0000    9.0579    1.5761
    7.0000   14.0000   10.0000    1.2699    9.7059
    2.0000    4.0000    5.0000    9.1338    9.5717
    5.0000   10.0000    8.0000    6.3236    4.8538
    8.0000   16.0000   11.0000    0.9754    8.0028
    3.0000    6.0000    6.0000    2.7850    1.4189
    6.0000   12.0000    9.0000    5.4688    4.2176
    9.0000   18.0000   12.0000    9.5751    9.1574
```

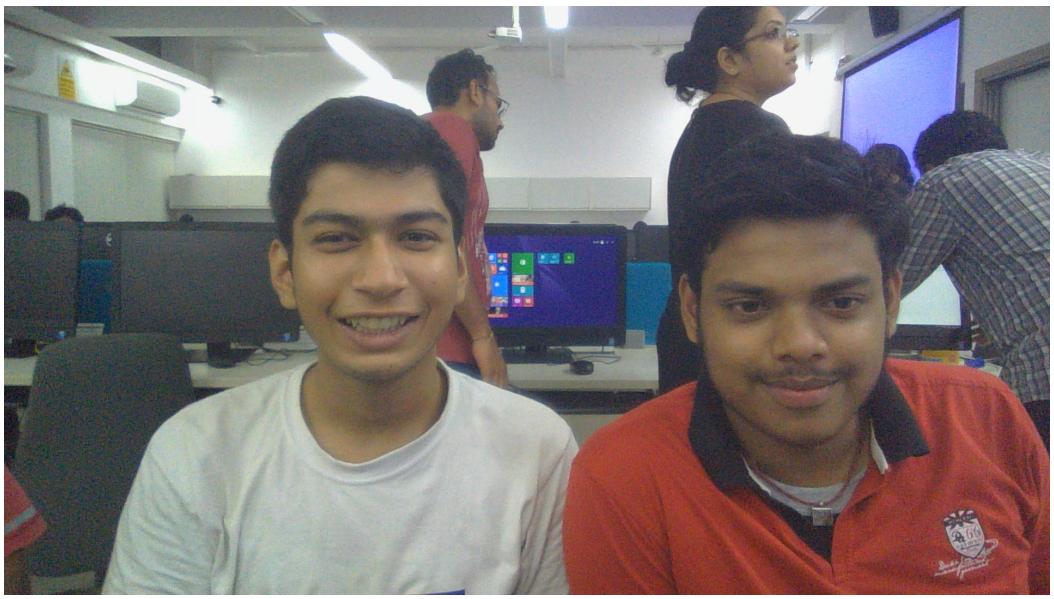
2. Obtaining the variance co-variance matrix

```
>> var_cov = cov(all_array)

var_cov =

    7.5000   15.0000    7.5000   -3.1729    1.5679
   15.0000   30.0000   15.0000   -6.3458    3.1357
    7.5000   15.0000    7.5000   -3.1729    1.5679
   -3.1729   -6.3458   -3.1729   11.8412    0.6353
    1.5679    3.1357    1.5679    0.6353   12.1146
```

3. Obtaining the correlation matrix using `corrcov()` function

```
>> corelation = corrcov(var_cov)

corelation =

    1.0000    1.0000    1.0000   -0.3367    0.1645
    1.0000    1.0000    1.0000   -0.3367    0.1645
    1.0000    1.0000    1.0000   -0.3367    0.1645
   -0.3367   -0.3367   -0.3367    1.0000    0.0530
    0.1645    0.1645    0.1645    0.0530    1.0000
```

Photo used for tutorial



1. **Importing Image “tut.JPG” to Matlab and saving its 3 bands as matrices namely tut4r, tut4g and tut4b**

```
>> uiopen('/Users/trailblazer/Documents/MATLAB/tut4.JPG',1)
>> tut4r=im2double(tut4(:,:,1));
>> tut4g=im2double(tut4(:,:,2));
>> tut4b=im2double(tut4(:,:,3));
```

2. **Concatenating all the arrays into one array as “ cat_rgb ” and Using *cov()* to obtain a variance covariance matrix(con_rgb)**

```
>> cat_rgb = cat(2,tut4r(:),tut4g(:),tut4b(:));
>> con_rgb=cov(cat_rgb)

con_rgb =

    0.0405    0.0366    0.0317
    0.0366    0.0474    0.0447
    0.0317    0.0447    0.0484
```

3. **Use *corrcov()* to obtain a correlation matrix.**

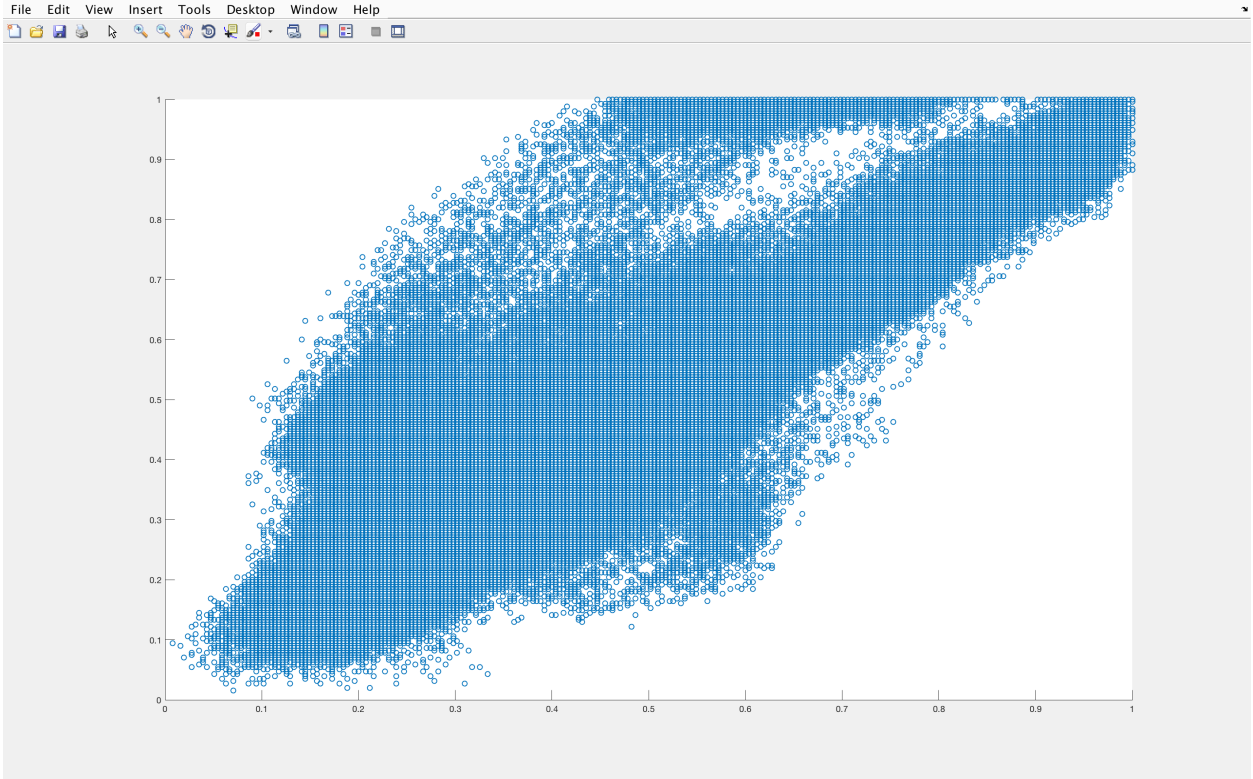
```
>> corr_rgb = corrcov(con_rgb)

corr_rgb =

    1.0000    0.8344    0.7153
    0.8344    1.0000    0.9342
    0.7153    0.9342    1.0000
```

- Correlation between tut4g(:) and tut4b(:) is highest i.e 0.9342.

4. **Visualising the correlation between tut4g(:) and tut4b(:) using scatter plot.**

```
>> figure
>> scatter(tut4g(:),tut4b(:))
```

Scatter Plot of tut4g(:) and tut4b(:)



Conclusion

- Correlation describes the degree to which one variable is linearly related to another. We got to know about calculating the variance covariance matrix of matrices.
- We used it to calculate correlation matrix of the 3 bands (red, green, blue) of a digital image. In order to get the correlation matrix we first concatenate the matrices into a single 2D matrix and the find its variance covariance matrix using the MATLAB function cov().
- Using another function corrcov() we got the correlation matrix. This gives an information of how much two different bands of an digital image is linearly related to each other.
- The correlation can also be visualised through a scatter plot which can be done using a function scatter().The sign of 'r' indicates direction of relationship between the two variables.
- The magnitude closer correlation closer to 1 means more dependent variables. Correlation being exactly 1 gives the scatter plot as straight line and means that the variables are proportional or related in perhaps more than 1 ways.

Some of applications of Multi-variate Image statistics in digital Image Processing

- Multi-variate Image analysis is a wide denomination that encloses classical studies on grey scale or RGB images, analysis of images collected using few spectral channels (sometimes called multispectral images) or, most recently, data treatments to deal with hyper spectral images, where the spectral direction is exploited in its full extension.
- Digital Image processing is also applied to simple images mainly for defect detection, segmentation and classification by the Computer Science community. Image analysis is becoming more important because of its ability to perform fast and non-invasive low-cost analysis on products and processes.