

E4266 PART II  
Tutorial 7

1. The following is a sample image of 5x5 pixels

23	14	179	243	233
16	234	155	177	2
14	234	12	28	173
200	149	176	20	17
73	1	188	39	208

A 2x2 template is given as below

12	28
175	20

- (a) Derive the equation of cross correlation (or ZNCC).
  - (b) Use the cross correlation technique to locate the most likely match in the sample image and give its matching score.
  - (c) Repeat (b) with SAD.
2. What are the major steps in PCA based face recognition?
- 3.

For the following square matrix:

$$\begin{pmatrix} 3 & 0 & 1 \\ -4 & 1 & 2 \\ -6 & 0 & -2 \end{pmatrix}$$

Decide which, if any, of the following vectors are eigenvectors of that matrix and give the corresponding eigenvalue.

$$\begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix} \begin{pmatrix} -1 \\ 0 \\ 2 \end{pmatrix} \begin{pmatrix} -1 \\ 1 \\ 3 \end{pmatrix} \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix}$$

4.

- What do the eigenvectors of the covariance matrix give us?
- At what point in the PCA process can we decide to compress the data? What effect does this have?

5. There are 2 clusters of 2-dimensional data. All example points are located at integer position.

Cluster-1: (5,9), (6,10), (7,10), (7,9)

Cluster-2: (17, 12), (18, 13), (19, 12), (19,14), (20,13)

- (1) Derive the cluster centers.
- (2) A test data is given as (10, 10). Determine which cluster it belongs to, using the NCC (Nearest Center Classifier).
- (3) Apply the PCA (Principal Component Analysis) to reduce the data into one dimension.
- (4) Derive the cluster centers in one dimension.
- (5) Transform the test data (10, 10) into the reduced data dimension and determine which cluster it belongs to.

