IE406: Machine Learning Lab

Assignment 6

(Date: 19/10/2021)

1. Given the following data use Principal Component Analysis to reduce the feature dimension from 3 to 1 also show eigen values. (Do manual calculation)

X_1	X_2	X_3
8	14	3
13	9	6
4	3	15
7	2	1
19	8	4
5	18	11

2. A classic application of PCA is to project the 3-D point cloud onto a plane that could still retain the information or essence of the point distribution. Given a 3-D point cloud, estimate an optimal plane, onto which if the 3D data points when projected would still retain the essential information. We provide you with 5 different point clouds P_1.txt to P_5.txt containing the 3D coordinates of points in space. Perform PCA on these point clouds to obtain their projection on a 2D plane and visualize the results using python libraries (like matplotlib).

3. Another classic example of PCA comes in image compression. The human eye cannot perceive the minute and frequent changes in the image. A typical smartphone camera takes a 5MP image on average. We will utilize PCA and analyze how the reduction in the no. of principal components or dimensions affects the visual quality of the image. Given an image, apply PCA to investigate the effect of reducing the dimensions on the visual quality of the image. You will use this image and show the analysis.

4. Load the Data matrix faceimages.mat given to you. There are 400 face images of size 112×92.

    a. Last column of the data is the class label. Column 1 to 10304 are 112×92 pixel.
    b. Each row represents one image.
    c. Construct the data matrix and Mean-center the data.
    d. Construct covariance matrix for the data.
    e. Solve eigenvalue problem to find projection matrix

    - Find low dimensional representation of Face images
    - Draw energy curve of PCA for the given data
    - Reconstruct any face image with 5, 10, 50 and 100 principal components.
    - Compute the reconstruction error for the same.

5. Apply PCA on the MNIST dataset. Plot cumulative sum of variance with no of components and find the minimum no. of component for 85% variance.

Note:
Submission Deadline: 11:59 PM, Tuesday, 26 October 2021
strictly follow the submission guidelines given in the classroom.