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Machine Learning

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OBS - 11

PCA and LDA

Aim :

To implement PLA and LDA and compare the performance with respect to time and accuracy of MLP and K-means clustering before and after applying dimensionality reduction on any dataset.

PCA algorithm :

* Write N datapoints $x_i = (x_1, x_2, \ldots, x_m)$ as row vectors.
* Put these vectors into a matrix X (which will have N x m)
* Centre the data by subtracting off the mean of each column putting it into matrix B.
* Compute the covariance matrix $C = \frac{1}{N} B^T B$
* Compute the eigenvalues and eigenvectors of C, so $V^{-1} C V = D$
* Where V holds the eigenvectors of C and D is the m x m diagonal eigenvalue matrix.
* Sort the columns of D into order, o decreasing eigen values and apply the same order to the columns of V.
* Reject those with eigen value less than and some leaving L dimensionless in the data.

LDA algorithm :

* Firstly, you need to calculate the separability between classes whiche its the distance between the mean of different classes. this is called the between-class variance.

$$S_b = \sum_{i=1}^{g} N_i (\bar{x}_i - x)(\bar{x}_i - \bar{x})^T$$

* seconly, calculate the distance between the mean and sample of each class. It is also called the within-class variance.

$$S_w = \sum_{i=1}^{g} (N_i - 1) S_i = \sum_{i=1}^{g} \sum_{j=1}^{N} (x_{ij} - \bar{x}_i)(x_{ij} - \bar{x}_i)^T$$

* Finally, construct the lower dimensional space which maximises the between-class variance and minimizes the within-class variance. P is considered as the lower dimensional space projection, also called Fisher's ~~fitration~~.

$$P_{lda} = \arg_P \max \frac{|P^T S_b P|}{|P^T S_W P|}$$