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Linear Discriminant Analysis (LDA)

Introduction

Linear Discriminant Analysis (LDA) is used to solve dimensionality reduction for data with higher attributes

- Pre-processing step for pattern-classification and machine learning applications.
- Used for feature extraction.
- Linear transformation that maximize the separation between multiple classes.
- “Supervised” - Prediction agent

Feature Subspace :

To reduce the dimensions of a d-dimensional data set by projecting it onto a (k)-dimensional subspace

(where k < d)

Feature space data is well represented?

- Compute eigen vectors from dataset
- Collect them in scatter matrix
- Generate *k*-dimensional data from d-dimensional dataset.

Scatter Matrix:

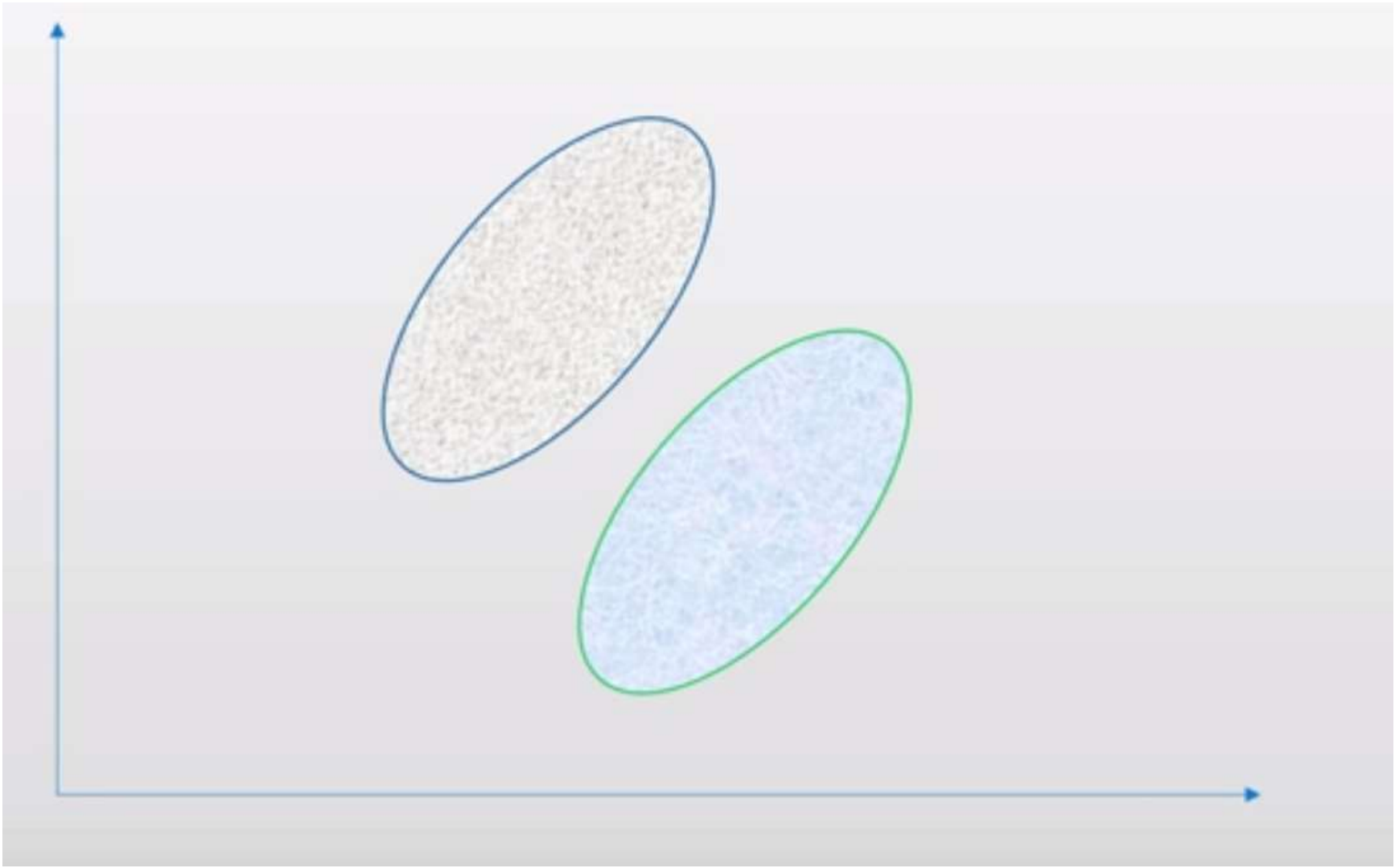
- Within class scatter matrix

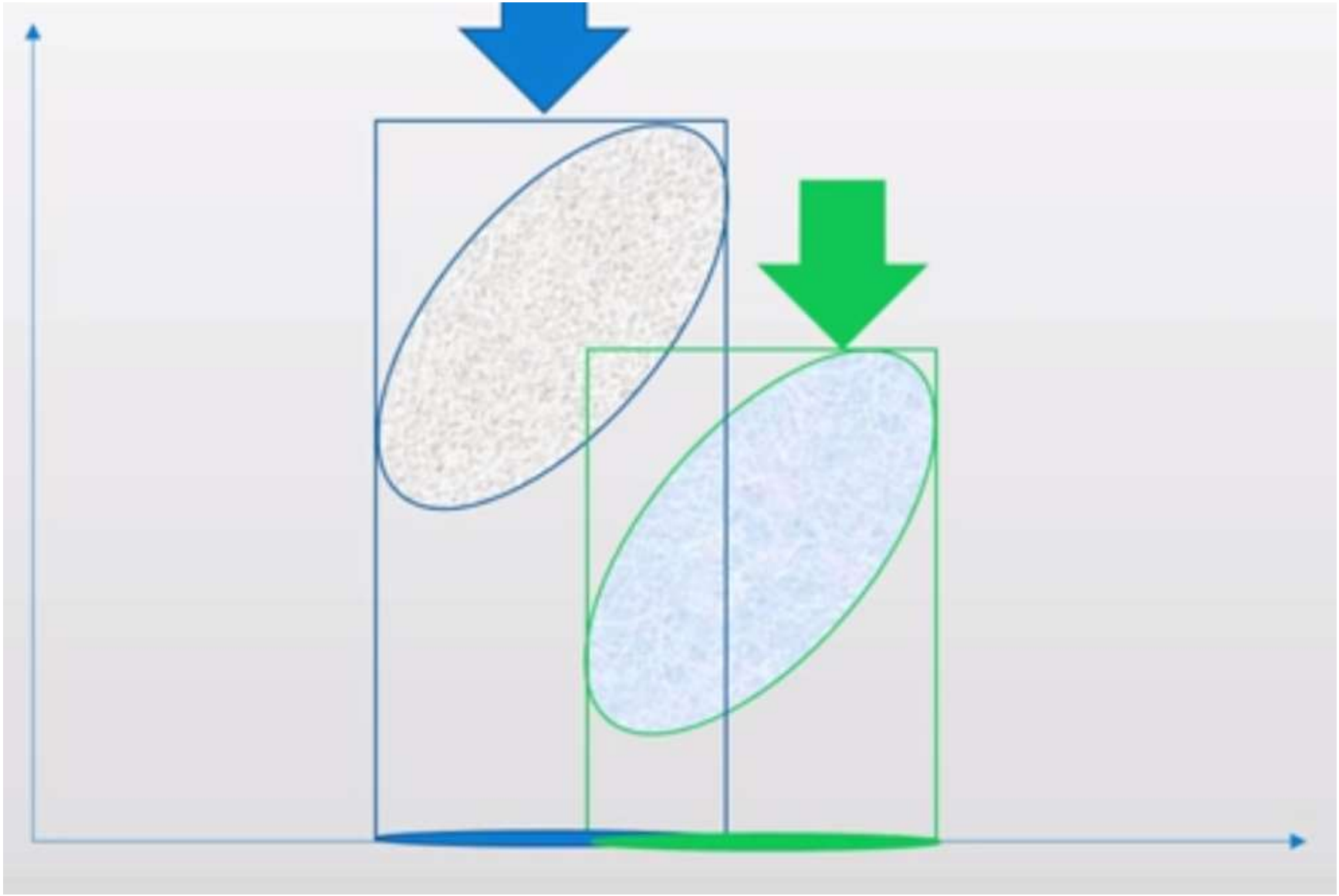
$$S_W = \sum_{i=1}^{c} S_i$$

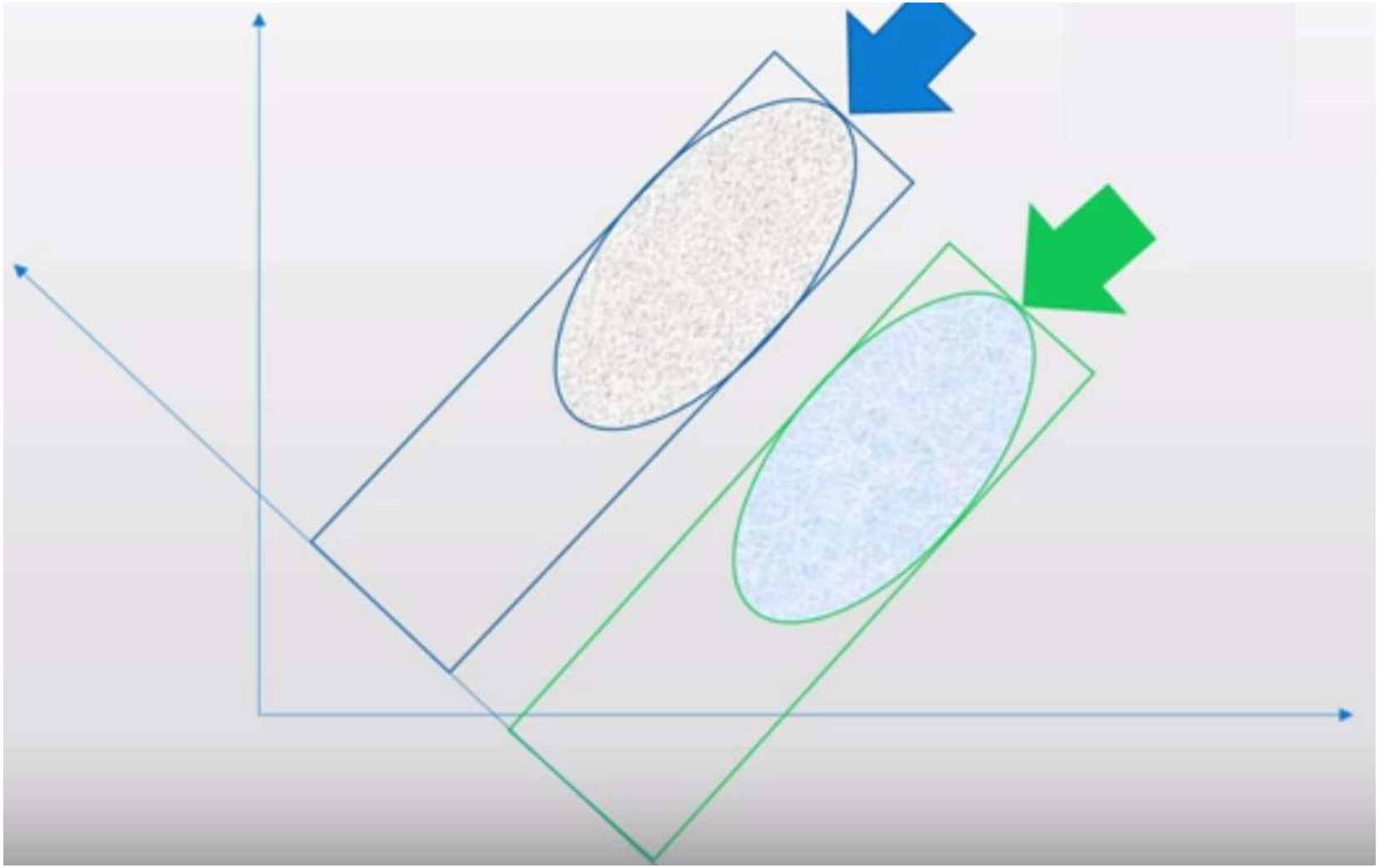
- In between class scatter matrix

$$S_B = \sum_{i=1}^{c} N_i (\boldsymbol{m}_i - \boldsymbol{m})(\boldsymbol{m}_i - \boldsymbol{m})^T$$

Maximize the between class measure & minimize the within class measure.







LDA steps:

1. Compute the d-dimensional mean vectors.
2. Compute the scatter matrices
3. Compute the eigenvectors and corresponding eigenvalues for the scatter matrices.
4. Sort the eigenvalues and choose those with the largest eigenvalues to form a d×k dimensional matrix
5. Transform the samples onto the new subspace.

Dataset

Attributes :

- X
- O
- Blank

Class:

- Positive(Win for X)
- Negative(Win for O)

Dataset

top-left-square	top-middle-square	top-right-square	middle-left-square	middle-middle-square	middle-right-square	bottom-left-square	bottom-middle-square	bottom-right-square	Class
x	x	x	x	o	o	x	o	o	positive
x	x	x	x	o	o	o	x	o	positive
x	x	x	x	o	o	o	o	x	positive
o	x	x	b	o	x	x	o	o	negative
o	x	x	b	o	x	o	x	o	negative
o	x	x	b	o	x	b	b	o	negative

References:

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[2]http://sebastianraschka.com/Articles/2015_pca_in_3_steps.html#a-summary-of-the-pca-approach

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[4] Sebastian Raschka, Linear Discriminant Analysis Bit by Bit, http://sebastianraschka.com/Articles/414_python_lda.html , 414.

[5] Zhihua Qiao, Lan Zhou and Jianhua Z. Huang, Effective Linear Discriminant Analysis for High Dimensional, Low Sample Size Data

[6] Tic Tac Toe Dataset - https://archive.ics.uci.edu/ml/datasets/Tic-Tac-Toe+Endgame