

Binary Classification Using (tensor) LDA

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Outline

Linear Discriminant Analysis

Tensor Linear Discriminant Analysis

Linear Discriminant Analysis

- ▶ **Task:** Implement a binary classifier for car detection.
- ▶ Using (conventional) Linear Discriminant Analysis.

Steps

- ▶ Calculate mean μ
 - ▶ For class 0, class 1, and for the overall dataset
- ▶ Calculate covariance matrix
 - ▶ S_B and S_W
- ▶ Calculate projector matrix w

Determine w

- w is a projection vector that maximally separates the data

$$\mathbf{w} = \arg \max_w \frac{\mathbf{w}^T \mathbf{S}_B \mathbf{w}}{\mathbf{w}^T \mathbf{S}_W \mathbf{w}} \quad (1)$$

Plot from S_W

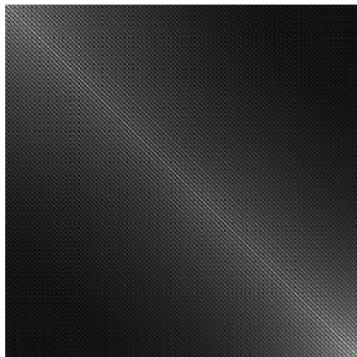


Figure 1: Plot from S_W

Plot from S_B

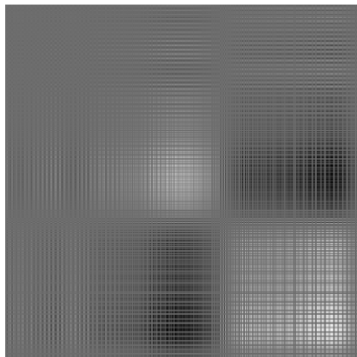


Figure 2: Plot from S_B

Plot from w

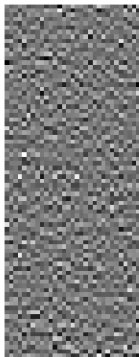


Figure 3: Plot from w

Result

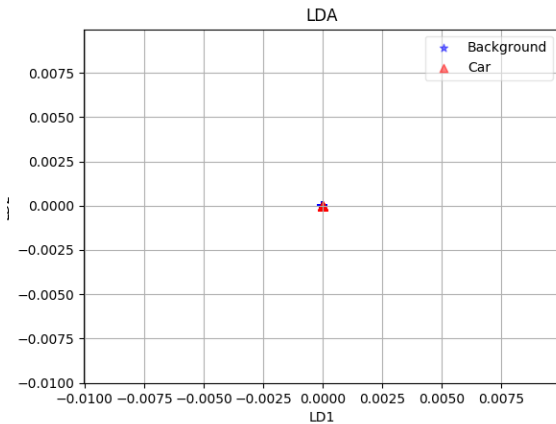


Figure 4: Result from LDA

Precision and recall

$$Precision = \frac{tp}{tp + fp} \quad (2)$$

$$Recall = \frac{tp}{tp + fn} \quad (3)$$

Precision and recall

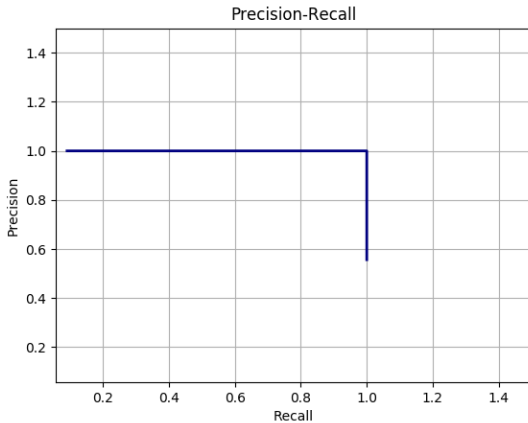
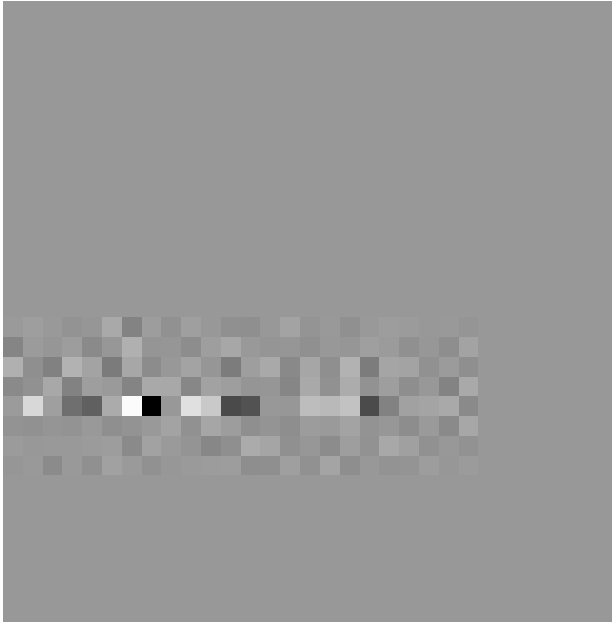


Figure 5: Precision and recall

Tensor Linear Discriminant Analysis

- ▶ **Task:** Implement a binary classifier for car detection.
- ▶ Using Tensor Linear Discriminant Analysis.

Tensor W output



Determine a projector w

$$y(X) = \begin{cases} +1, & \text{if } w^T x \geq \theta \\ -1, & \text{otherwise} \end{cases} \quad (4)$$