SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING-IoT Including CS & BCT

COURSE NAME :19SB701 PATTERN RECOGNITION TECHNIQUES IN CYBER CRIME

IV YEAR / VII SEMESTER

Unit II- **CLASSIFIERS BASED ON BAYESIAN DECISION THEORY**

Topic :Discriminant Functions, and Decision Surfaces

1. Introduction to Discriminant Functions

Purpose:

Discriminant functions are mathematical functions used to classify data points into different classes by calculating a score for each class and assigning the data point to the class with the highest score.

Usage: They are commonly used in pattern recognition, machine learning, and statistics to build classifiers, especially in scenarios where data is linearly or non-linearly separable.

2. Types of Discriminant Functions

Linear Discriminant Function:

Formula: A linear discriminant function for class ωiω i is given by

$$g_i(\mathbf{x}) = \mathbf{w}_i^T \mathbf{x} + w_{i0}$$

where wiw i is the weight vector and $wi0$w i0 is the bias term.

Interpretation:

The function $gi(x)$g i (x) represents a hyperplane in the feature space.

The data point xx is classified into the class for which the discriminant function value is the highest.

Quadratic Discriminant Function:

Formula: A quadratic discriminant function for class ωiω i is given by

$$g_i(\mathbf{x}) = \mathbf{x}^T \mathbf{A}_i \mathbf{x} + \mathbf{b}_i^T \mathbf{x} + c_i$$

where AiA i is a matrix, bib i is a vector, and cic i is a scalar.

Interpretation:

This function allows for more complex decision boundaries that can handle non-linearly separable data.

Generalized Discriminant Function:

Formula: A generalized discriminant function can be any function that maps the feature vector xx to a scalar score:

$$g_i(x) = f(x; \theta_i)$$

where θiθ i represents the parameters of the function.

Interpretation:

This allows for a wide range of decision boundaries, depending on the form of the function $f(x;\theta i)$f(x;θ i).

3. Decision Surfaces

Definition: A decision surface (or decision boundary) is a surface in the feature space that separates different classes based on the discriminant functions.
It is the locus of points where two or more discriminant functions are equal.

Types:

Linear Decision Surface:
Arises from linear discriminant functions.
The decision surface is a hyperplane.

Example: In a 2D feature space, the decision boundary is a straight line.

Non-linear Decision Surface:

Arises from quadratic or higher-order discriminant functions.

The decision surface can be a curve or any other complex shape.

Example: In a 2D feature space, the decision boundary could be a circle, ellipse, or any arbitrary curve.

4. Examples of Discriminant Functions and Decision Surfaces

Example 1: Linear Discriminant Analysis (LDA): LDA uses linear discriminant functions to classify data. The decision surface is linear, resulting in hyperplanes separating different classes.

Example 2: Quadratic Discriminant Analysis (QDA): QDA uses quadratic discriminant functions, allowing for non-linear decision surfaces that can separate more complex class distributions.

Any Query????

Thank you……