

Linear Classification A

Consider a problem of classification into three classes and a 2D space of points $\mathbf{x} = [x_1, x_2]^\top$. For each class we have following data (transposition will be left out for simplified notation, but all vectors are implicitly in columns).

$$\text{A: } \mathcal{T} = \{[0, -1.0], [1, 2.0]\}$$

$$\text{B: } \mathcal{T} = \{[2, 0.0], [4, 0.5]\}$$

$$\text{C: } \mathcal{T} = \{[5, 0.5], [6, 5.0]\}$$

Find the parameters of the discrimination function so that

$$s^* = \arg \max_{s \in S} f_s(\mathbf{x}) \quad (1)$$

will classify these data without mistakes. The discrimination function is linear (affine), in form of

$$f_s(\mathbf{x}) = \mathbf{w}_s^\top \mathbf{x} + w_{s0} \quad (2)$$

For every class, we are trying to find three numbers (\mathbf{w}_s and w_{s0}). For completeness, it should be pointed out that valid solution is not a drawing lines into a graph, but finding the three numbers for each of these classes.