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CK0146: Homework A

Exercise A.1. Consider the sum-of-squares error function

$$E(\mathbf{w}) = \frac{1}{2}\sum_{n=1}^{N}\Big(y(x_n,\mathbf{w}) - t_n\Big)^2, \tag{1}$$

in which the function $y(x,\mathbf{w})$ is given by the polynomial

$$y(x,\mathbf{w}) = w_0 + w_1 x + w_2 x^2 + \cdots + w_M x^M = \sum_{j=0}^{M} w_j x^j. \tag{2}$$

Show that the coefficients $\mathbf{w} = \{w_i\}$ that minimise this error function are given by the solution of the following set of linear equations

$$\sum_{j=0}^{M} A_{ij} w_j = T_i, \tag{3}$$

where

$$A_{ij} = \sum_{n=1}^{N} (x_n)^{j+1}; \tag{4a}$$

$$T_i = \sum_{n=1}^{N} (x_n)^i t_n. \tag{4b}$$

Suffix i or j denotes the index of a component, whereas $(x)^i$ denotes x raised to the power of i.

Solution: Substituting Equation 2 into Equation 1 and then differentiating w.r.t. w_j, we obtain

$$\sum_{n=1}^{N}\Big(\sum_{j=0}^{M} w_j x_n^j - tn\Big)x_n^i = 0.$$

Rearranging terms gives the required result.

Exercise A.2. $\cdots$

Solution: $\cdots$