भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology
Hyderabad

Supervised Learning

Teaching Learning Center
IIT Hyderabad

G V V Sharma*

Contents

***Abstract*—This manual introduces various methods in supervised learning.**

1 Least Squares Method

1.1 The Steinhart–Hart equation is a model of the resistance of a thermistor at different temperatures. The equation is given by

$$\frac{1}{\tau} = w_1 + w_2 \ln(R) + w_3[\ln(R)]^3 \tag{1.1}$$

Let

$$\mathbf{a}_1 = \begin{pmatrix} 1 \\ \ln(R_1) \\ [\ln(R_1)]^3 \end{pmatrix} \tag{1.2}$$

$$y_1 = \frac{1}{\tau_1} \tag{1.3}$$

$$\mathbf{w} = \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} \tag{1.4}$$

Show that

$$y_1 = \mathbf{a}_1^T \mathbf{w} \tag{1.5}$$

1.2 Suppose for $n > 3$

$$\mathbf{y} = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}, A^T = \begin{pmatrix} \mathbf{a}_1 & \mathbf{a}_2 & \vdots & \mathbf{a}_n \end{pmatrix}, \tag{1.6}$$

show that

$$\mathbf{y} = A\mathbf{w} \tag{1.7}$$

1.3 For $\tau = 10^{\circ}C - 100^{\circ}C$, use the PT-100 resistance table to estimate $\mathbf{w}$ using the relation

$$\hat{\mathbf{w}} = \left(A^T A\right)^{-1} A\mathbf{y} \tag{1.8}$$

1.4 Verify your result by finding the temperature when the resitance is 175.86Ω.

*The author is with the Department of Electrical Engineering, Indian Institute of Technology, Hyderabad 502285 India e-mail: gadepall@iith.ac.in.