Chapter 5

Separation of Internal Representations of the Hidden Layer

Exercises

5.1 In the variant of the infomax principle, the objective is to maximize the mutual information I (Ya; Yb) between the outputs Ya and Yb of a noisy neural system due to the input vectors Xa and Xb. In another approach discussed in Becker and Hinton (1992), a different objective is set: maximize the mutual information $I(\frac{Ya+Yb}{2}; S)$ between the average of the outputs Ya and Yb and the underlying signal component S common to these two outputs. Using the noisy model

$$Ya = S + Na$$

and

$$Yb = S + Nb,$$

do the following:

(a) Show that

$$I(\frac{Ya+Yb}{2}; S) = \frac{\text{var}[Ya+Yb]}{\text{var}[Na+Nb]}$$

where Na and Nb are the noise components in Ya and Yb, respectively.

(b) Give the interpretation of this mutual information as a signal-plus noise to noise ratio.

5.2 Discuss and analyze the net:

$$x_j(t+1) = \sigma\left(\sum w_{ji} x_i(t) - s_j\right), \quad i, j = 1 \sim 3.$$

$$x_j(t+1) = \sigma\left(\vec{w}_j X(t) - s_j\right)$$

$$X(t+1) = \sigma\left(WX - S\right)$$

and $$W\begin{bmatrix}1\\1\\1\end{bmatrix} = 2S.$$