
UNIVERSITY OF ILLINOIS
Department of Electrical and Computer Engineering
ECE 417 MULTIMEDIA SIGNAL PROCESSING

Lecture 22 Sample Problem Solutions

Problem 22.1

$$E = \frac{1}{n} \sum_{i=1}^n E_i$$
$$E_i = -\ln y_{k^*,i}$$

$$\frac{\partial E_i}{\partial u_{kj}} = \frac{\partial E_i}{\partial a_{ki}} \frac{\partial a_{ki}}{\partial u_{kj}}$$
$$= \epsilon_{ki} x_{ji}$$

$$\epsilon_{ki} = y_{ki} - \zeta_{ki}$$

$$y_{ki} = \frac{e^0}{e^0 + e^0} = \frac{1}{2}$$

$$\epsilon_{ki} = \begin{cases} -1/2 & k = 1, 1 \leq i \leq 100 \text{ or } k = 2, 101 \leq i \leq 200 \\ 1/2 & k = 2, 1 \leq i \leq 100 \text{ or } k = 1, 101 \leq i \leq 200 \end{cases}$$

$$x_{ji} = \begin{cases} 2 & j = 1, 1 \leq i \leq 100 \text{ or } j = 2, 101 \leq i \leq 200 \\ -2 & j = 2, 1 \leq i \leq 100 \text{ or } j = 1, 101 \leq i \leq 200 \end{cases}$$

$$U = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} - \frac{1}{200} \left(100 \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix} + 100 \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix} \right)$$
$$= \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

Problem 22.2

$$\begin{aligned}\vec{x}_i &= \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \end{bmatrix} \\ \vec{\zeta}_i &= \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \end{bmatrix} \\ \vec{a}_i &= \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix} \\ \vec{y}_i &= \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix} \\ \vec{b}_i &= \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix} \\ \vec{z}_i &= \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ 1/2 \end{bmatrix} \\ \vec{\epsilon}_i &= \begin{bmatrix} -1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} -1/2 \\ 1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ -1/2 \end{bmatrix}, \begin{bmatrix} 1/2 \\ -1/2 \end{bmatrix} \\ \vec{\delta}_i &= \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix} \\ V &\leftarrow \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \\ U &\leftarrow \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}\end{aligned}$$