ENEE 434 Spring 2003
To Do #3

1. Design a neural network to give the following six input output pairs

$$p_1 = t_1 = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\1\\0\\0\\0\\0\end{bmatrix}, p_2 = t_2 = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\-1\\0\\0\\0\\0\end{bmatrix}, p_3 = t_3 = \frac{1}{\sqrt{2}}\begin{bmatrix}0\\0\\1\\1\\0\\0\end{bmatrix},$$

$$p_4 = t_4 = \frac{1}{\sqrt{2}}\begin{bmatrix}0\\0\\1\\-1\\0\\0\end{bmatrix}, p_5 = t_5 = \frac{1}{\sqrt{2}}\begin{bmatrix}0\\0\\0\\0\\1\\1\end{bmatrix}, p_6 = t_6 = \frac{1}{\sqrt{2}}\begin{bmatrix}0\\0\\0\\0\\1\\-1\end{bmatrix}$$

Use the activation function for small positive ε

$$f(n) = \begin{cases} +1 & \text{for } \varepsilon < n \\ \dfrac{n}{\varepsilon} & \text{for } -\varepsilon \le n \le \varepsilon \\ -1 & \text{for } n < -\varepsilon \end{cases}$$

Check that the desired output results for all these inputs and then try your network on

$$p_{test} = \begin{bmatrix}0.01\\-0.02\\1.01\\-1.02\\-0.04\\0.05\end{bmatrix}$$

2. For the above problem
   a. Form $P = [p_1\ p_2\ p_3\ p_4\ p_5\ p_6]$ and find its inverse.
   b. Investigate properties of P; is it
      Symmetric, Orthogonal, Of trace zero, Self inverse, Positive definite?
   c. Discuss the means to transform any real nonsingular 6x6 matrix Q into P and carry out your procedure on

$$Q = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 0 & 1 & 2 & 3 & 4 & 5 \\ 0 & 0 & 1 & 2 & 3 & 4 \\ 0 & 0 & 0 & 1 & 2 & 3 \\ 0 & 0 & 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

3. Look into the effects of using $\varepsilon < 0$ in the activation function of problem 1 (on redefining the middle range to go over $\varepsilon \leq n \leq -\varepsilon$). Note that this gives a 3-valued activation function which when realized by hardware is a type of hysteresis.