ENEE434 Spring 2003 WS/RWN 04/17/03
Homework # 5
50 points, due Thursday, April 24, 2003

Refer to the paper, "A Neural Network With Asymmetric Basis Functions for Feature Extraction of ECG P Waves," presented by V. P. Kumar. Consider the neural network in figure 1.

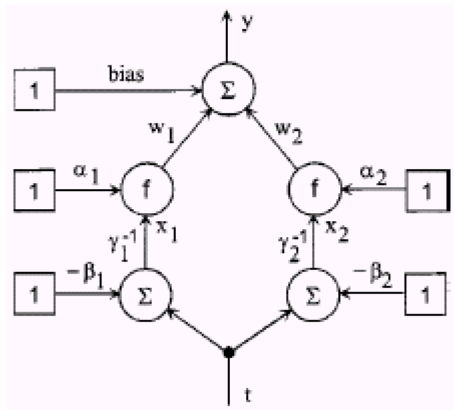

Fig. 1. A neural network for P wave feature extraction using two asymmetric basis functions.

The network input-output relationship is given in equation 3 in the paper as

$$x_i = \gamma_i^{-1}(t - \beta_i) \qquad i = 1, 2$$

$$\text{out}_i = f(x_i, \alpha_i)$$

$$y = w_1 \text{out}_1 + w_2 \text{out}_2 + \text{bias}. \qquad (3)$$

where

$$f(x, \alpha) = \frac{2 + \alpha^2}{1 + \exp(-\alpha^2 x) + \alpha^2 \exp(x)}$$

1. Given network parameters as resulted from numerical tests (section IV in the paper), i.e.
$$\alpha_1 = -0.4262, \alpha_2 = -0.7032, \quad \beta_1 = 37.5915, \beta_2 = 53.2531,$$
$$w_1 = 0.5996\ w_2 = 0.8903, \text{bias} = 0.1048,$$
$$\gamma_1 = 1.7730, \gamma_2 = 1.7721.$$
calculate the outputs of the neural network in figure 1 at times t in {1,2}.

2. Given a training set $\{(d_1, t_1), (d_2, t_2)\} = \{(0.06, 1), (0.04, 2)\}$, where d_i is the desired output corresponding to the input time t_i, i = 1, 2, give the results of performing one iteration of training the neural network in part 1 with the learning rate = 1. Note that the cost function to be used is given in equation 5 in the paper as
$$E = \tfrac{1}{2}(d_j - y_j)^2; \qquad j = 1, 2, \ldots, ns \qquad (5)$$