EEL 878: Artificial Intelligence for Control Applications

MAJOR TEST

Time: 2 hrs
Max Mark: 30
April 30, 2008

Q1: Assume that ANFIS (Adaptive Neuro-Fuzzy Inference System) has two inputs, x_1 and x_2, and one output y. Each input is represented by two fuzzy sets, and the output by a zero-order polynomial ($y = k$, where k is a constant). Represent this ANFIS by a six-layer feedforward neural network and describe the operations involved at each layer. .... 5 marks

Q2: Consider the fuzzy system concerning the terminal voltage and speed of an electric motor, described by the membership functions

x	100	150	200	250	300
$\mu_{\tilde{A}}(x)$	1	0.8	0.5	0.2	0

y	1600	1800	2000	2200	2400
$\mu_{\tilde{B}}(y)$	1	0.9	0.7	0.3	0

Input: Voltage is rather small (x is $\tilde{A}'$)

Rule: IF voltage is small (x is $\tilde{A}$) THEN speed is small (x is $\tilde{B}$)

Inference: Speed is rather small (y is $\tilde{B}'$)

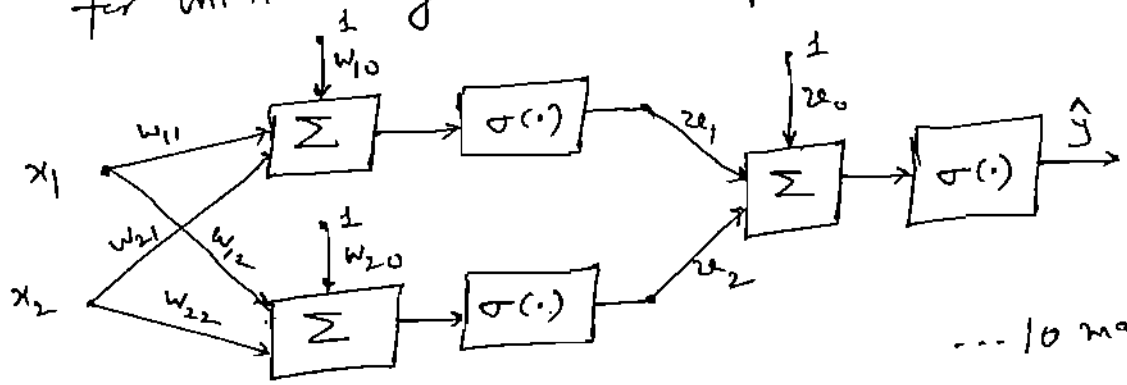
Assume that the input fuzzy set $\tilde{A}'$

is a singleton at $x_0 = 125$. Determine the inference fuzzy set $\tilde{B}'$ of the fuzzy system. Use piecewise continuous approximations of graphs of $\mu_{\tilde{A}}(x)$ and $\mu_{\tilde{B}}(y)$. ..... 10 marks

Q3 Consider the network shown in the figure. $\sigma(a) = \frac{1}{1+e^{-a}}$; 'a' represents the activation value for the node. The learning constant $\eta = 0.1$. The desired output is y. The initial weights are:
$w_{10} = 1$, $w_{11} = 3$, $w_{12} = 4$, $w_{20} = -6$, $w_{21} = 6$, $w_{22} = 5$
$v_0 = -3.92$, $v_1 = 2$ and $v_2 = 4$

(a) with input vector $\underline{x} = [1 \quad 0]^T$ and desired output $y = 1$, update the weights for one step.

(b) Compute the error with the same input, for initial weights and updated weights.



... 10 marks

Q4 A function approximation problem has to be solved. We want to attempt an SVM (Support Vector Machine) solution. We decide to try first a linear regression hyperplane. Explain the SVM algorithm that serves this objective.

... 5 marks