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प्रज्ञानं ब्रह्म

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MANIPAL INSTITUTE OF TECHNOLOGY

(Constituent Institute of Manipal University)MANIPAL576104

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MANIPAL INSTITUTE OF TECHNOLOGY

SEVENTH SEMESTER B.E. (CSE) DEGREE END SEMESTER EXAMINATION

December 2010

NEURAL NETWORK AND FUZZY SYSTEMS (CSE 405.2)

(REVISED CREDIT SYSTEM)

TIME: 3 HOURS MAX.MARKS: 50

Instruction to Candidates

- Answer **any five** full questions
- Missing data can be suitably assumed

1 A) Along with the block diagram and equations, explain the model of a neuron.

(5)

1 B) What is memory based learning? What are the two essential ingredients of memory based learning?

(1+2)

1 C) Consider a 3-class problem and K-nearest neighbor classifier with K=5. Given a Xtest, K-nearest neighbor produces the {x1,x2,x3,x4,x5} neighbors from the training set. If {x1} $\in$ class-1, {x2,x3,x4} $\in$ class-2 and {x5} $\in$ class-3. Then what is the class predicted by K-nearest neighbor? Justify.

(2)

2 A) Using necessary equations prove the perceptron convergence theorem.

(5)

2 B) Consider a 4-class decision problem.

$$\left\{p_1=\begin{bmatrix}1\\1\end{bmatrix},\ t_1=\begin{bmatrix}0\\0\end{bmatrix}\right\}\left\{p_2=\begin{bmatrix}1\\2\end{bmatrix},\ t_2=\begin{bmatrix}0\\0\end{bmatrix}\right\}\left\{p_3=\begin{bmatrix}2\\-1\end{bmatrix},\ t_3=\begin{bmatrix}0\\1\end{bmatrix}\right\}\left\{p_4=\begin{bmatrix}2\\0\end{bmatrix},\ t_4=\begin{bmatrix}0\\1\end{bmatrix}\right\}$$

$$\left\{p_5=\begin{bmatrix}-1\\2\end{bmatrix},\ t_5=\begin{bmatrix}1\\0\end{bmatrix}\right\}\left\{p_6=\begin{bmatrix}-2\\1\end{bmatrix},\ t_6=\begin{bmatrix}1\\0\end{bmatrix}\right\}\left\{p_7=\begin{bmatrix}-1\\-1\end{bmatrix},\ t_7=\begin{bmatrix}1\\1\end{bmatrix}\right\}\left\{p_8=\begin{bmatrix}-2\\-2\end{bmatrix},\ t_8=\begin{bmatrix}1\\1\end{bmatrix}\right\}$$

Initial weight and bias values are $W(0)=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$ and $b(0)=\begin{bmatrix}1\\1\end{bmatrix}$. Using perceptron rule determine new weight and bias values after applying P1 to P5 patterns sequentially. Show all necessary calculations.

(5)

3 A) Along with neat diagram explain the state-space model.

(4)

3 B) Write the differences between recurrent autoassociative network and recurrent heteroassociative network.

(3)

3 C) For the case of liner heteroassociative memory, consider a pattern $S^{(j)'} = S^{(j)} + \Delta^{(j)}$, where $S^{(j)}$ is original pattern, $\Delta^{(j)}$ is distortion term. Suppose $S^{(j)'}$ is submitted to the memory, write interms of equations, what vector will be retrieved when

i. Input stimuli vectors $\{S^{(1)}, S^{(2)} .... S^{(p)}\}$ are not orthonormal.

ii. Input stimuli vectors $\{S^{(1)}, S^{(2)} .... S^{(p)}\}$ are orthonormal.

(3)

4 A) Explain two basic models for feature map. Also explain two phases of adaptive process used in SOM.

(5)

4 B) In the self organizing maps, how cooperative process is different from competitive process? Also provide various equations involved in cooperative and competitive processes.

(5)

5 A) Consider the following fuzzy set A,

$$A = \bigcup_{w_i \in W} \mu_A(w_i) / w_i$$

A=0.03/91 U 0.59/193 U 0.41/151 U 0.94/211 U 0.35/146

Provide the definition for scalar product of a fuzzy set and power of a fuzzy set.

Determine and write the resulting fuzzy sets for followings

i. Complement of fuzzy set A

ii. For scalar 0.21, find the scalar product of fuzzy set A.

iii. For power 2, find the power set of A **(5)**

5 B) What do mean by alpha cuts? Consider a fuzzy set

A=0.21/51 U 0.32/62 U 0.54/73 U 0.79/97 U 0.88/105 U 0.91/197

Find the alpha cuts for $\alpha = 0.35$ and $\alpha = 0.55$. **(3)**

5 C) Write idempotency and commutativity properties of fuzzy sets. **(2)**

6 A) What is fuzzy inference engine? In fuzzy inference engine for computing heart attack risk, one of the inputs is electrocardiogram. Explain three different ways of inputing electrocardiogram to this inference engine.

(5)

6 B) Explain the fuzzy classification networks using backpropagation and fuzzy associative memories.

(5)