Question 1 (5 Marks)

Show that a standard artificial neuron with the activation function as a generic threshold function is a special case of the stochastic artificial neuron.

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Question 2 (9 Marks)

Obtain the objective function to be minimized in order to find the maximum log-likelihood estimate of linear regression parameters when the intrinsic zero-mean random error of the model follows the Laplacian distribution. Assume the i.i.d. property as required properly mentioning it. Note: a Laplacian random variable x with mean μ has the PDF: $p(x) = \frac{1}{2\sigma}\exp\left(-\frac{|x-\mu|}{\sigma}\right)$.

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Question 3 (6 Marks)

While instantaneous training of an LMS algorithm yielding $y(n)$ at the time n using K number of weights ($\overline{w}(n) = [w_1(n), w_2(n), \ldots, w_K(n)]$), the cost function used was:

$$\frac{1}{2}e^2(n) + \beta(\|\overline{w}(n)\|_2)^2, \text{ with } e(n) = d(n) - y(n)$$

where $d(n)$ is the ideal output and $\|\overline{a}\|_2 = \sqrt{(\sum_{k=1}^{K} a_k^2)}$ represents the Euclidean norm of $\overline{a}$. What was the update expression for the k^{th} weight from time n to $n+1$? Suitable approximations, if required, may be taken with proper justification, to the find the above.

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