CSE301 Biocomputation, 2016

Week 5 Tutorial Exercises on MLP

Q1. What is the purpose of momentum in back-propagation learning? Briefly explain how this purpose is achieved.

Q2. Briefly describe the cross-validation based early stopping criteria for neural network learning. What are its benefits.

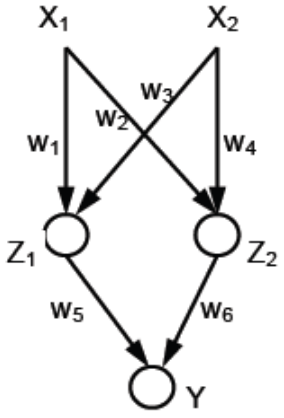
Q3. State the requirements for a neural network for it to be a universal approximator.

Q4. Describe the classification/decision rule for a (a) single-layer perceptron, and (b) multi-layer perceptron. Assume a general k-class problem where k > 2.

Q 5 In the Back-Propagation learning algorithm, what is the object of the learning? Does the Back-Propagation learning algorithm guarantee to find the global optimum solution?

Q 6. Consider a two-layer MLP that has the topology shown in the figure.

- *X1* and *X2* are the two inputs.
- *Z1* and *Z2* are the two hidden neurons.
- *Y* is the (single) output neuron.
- *wi*, i=1..4, are the weights of the connections from the inputs to the hidden neurons.
- *wj*, j=5..6, are the weights of the connections from the hidden neurons to the output neuron.



Explain the three phases (i.e., input signal forward, error signal backward, and weight update) of **the first training iteration** of the Backpropagation algorithm for the current network, given the training example: (*X1*=x1, *X2*=x2, *Y*=y).

Please use the following notations for the explanation.

- *Net1*, *Net2*, and *Net3* are the net inputs to the *Z1*, *Z2*, and *Y* neurons, respectively.
- *o1*, *o2*, and *o3* are the output values for the *Z1*, *Z2*, and *Y* neurons, respectively.
- *f* is the activation function used for every neuron in the network, i.e., ok=f(Netk), k=1..3.
- E(**w**) = $(y - o3)^2 / 2$ is the error function, where *y* is the desired network output.
- η is the learning rate
- $\delta 1$, $\delta 2$, and $\delta 3$ are the error signals for the *Z1*, *Z2*, and *Y* neurons, respectively

Q7. Apply the BP algorithm to find the new weights of a feedforward neural network after applying the input-output pattern ({1, 1}, 0). Assume the network has a single hidden layer with 2 neurons and all weights are initially zero All neurons use the logistic activation function.

Q8. Consider a two-layer feedforward network with two inputs, one hidden neuron, and one output neuron. All neurons use the logistic activation function. Use the BP algorithm with momentum to update the weights of networks after each of the training examples {(1, 0), 1} and {(0, 1), 0}. Assume all weights are initially equal to 1, η = 0.2, and α = 0.9. Show your working.