

# T-61.5130 Machine Learning and Neural Networks Examination 12th December 2014/Karhunen

(Voit vastata tenttiin myös suomeksi.)

1. Answer briefly (using a few lines) to the following questions or items:
  - (a) Which neural network method is based on competitive learning?
  - (b) How is Hessian matrix defined?
  - (c) For what purpose is weight decay used?
  - (d) What means curse of dimensionality?
  - (e) Explain briefly  $\epsilon$ -insensitive cost function.
  - (f) What is the relationship between standard finite-duration impulse response (FIR) filter and focused neuronal filter?
2. Construct a multilayer perceptron network which is able to separate the two classes  $\mathcal{C}_1$  and  $\mathcal{C}_2$  illustrated in Figure 1 on the reverse side. Use two neurons both in the input and output layer and an arbitrary number of hidden layer neurons. The output of the network should be vector  $[1, 0]^T$  if the input vector belongs to class  $\mathcal{C}_1$  and  $[0, 1]^T$  if it belongs to class  $\mathcal{C}_2$ . Use the hard-limiter nonlinear activation function for all the neurons and determine their weights by hand without using any specific learning algorithm.
3. Compare multilayer perceptron networks trained using backpropagation type algorithms with extreme learning machine. Describe their overall structure and learning methods (no formulas are required). What are their benefits and drawbacks?
4. Figure 2 on the reverse side shows an example of a second-order recurrent network including some notation. Write out the dynamical equation(s) describing the operation of the network and its input-output mapping. The multiplier nodes, denoted by the symbol  $\otimes$ , multiply their inputs. The activation function used is the standard logistic sigmoidal function. Include also bias terms which are not shown in the figure for clarity.



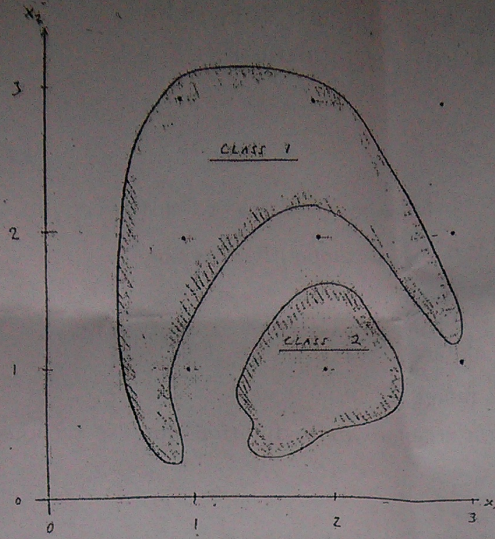


Figure 1: Classes  $C_1$  and  $C_2$ .

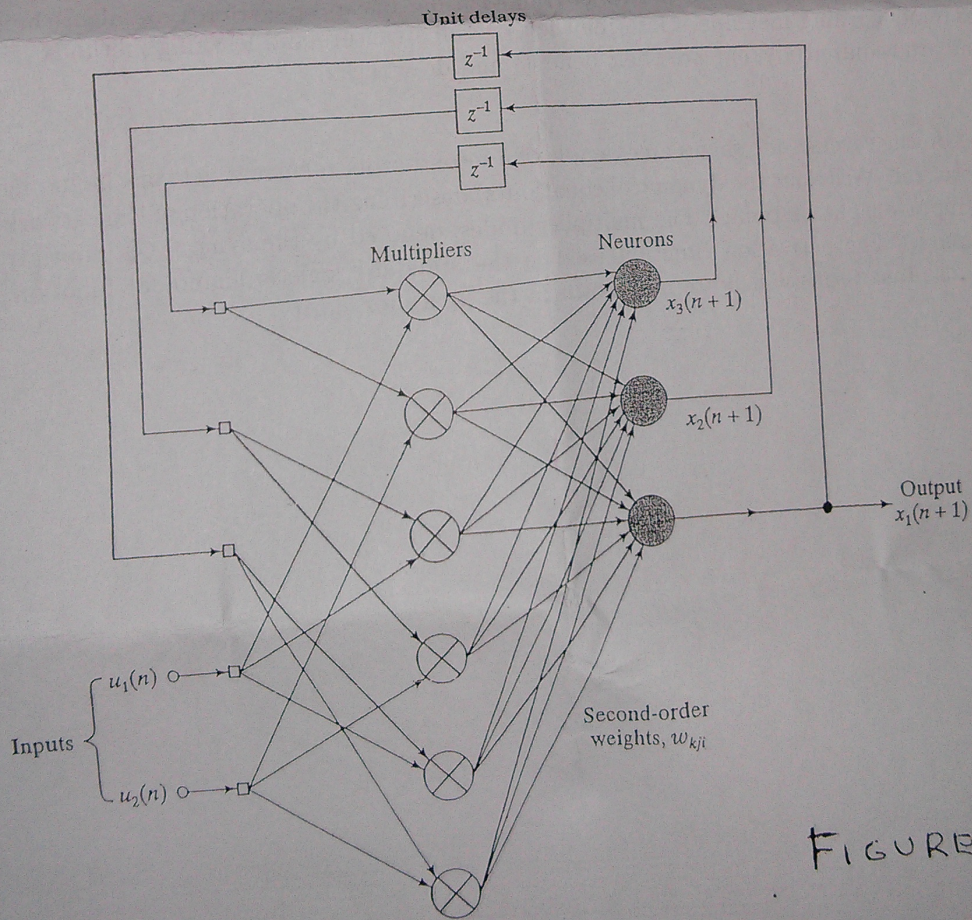


FIGURE 2