

T-61.5130 Machine Learning and Neural Networks Examination 20th December 2013/Karhunen

1. Answer briefly (using a few lines) to the following questions or items:

- (a) For what purpose and where is momentum term used?
- (b) What is cross-validation?
- (c) Which are the two main criteria for measuring non-Gaussianity?
- (d) Explain briefly ϵ -insensitive cost function.
- (e) Which neural network method is based on competitive learning?
- (f) Explain briefly what is NARX model.

2. In the steepest descent method the adjustment $\Delta \mathbf{w}(n)$ applied to the parameter vector $\mathbf{w}(n)$ is defined by $\Delta \mathbf{w}(n) = -\eta \mathbf{g}(n)$, where η is the learning-rate parameter and

$$\mathbf{g}(n) = \left. \frac{\partial \mathcal{E}_{av}(\mathbf{w})}{\partial \mathbf{w}} \right|_{\mathbf{w}=\mathbf{w}(n)}$$

is the local gradient vector of cost function $\mathcal{E}_{av}(\mathbf{w})$ averaged over the learning samples. How could you determine the learning rate parameter η so that it minimizes the cost function $\mathcal{E}_{av}(\mathbf{w})$ as much as possible?

3. Consider solving the XOR problem using an RBF network. In the XOR problem the desired output is 0 for the vectors $(1, 1)^T$ and $(0, 0)^T$ belonging to the first class. For the vectors $(1, 0)^T$ and $(0, 1)^T$ belonging to the second class the desired output is 1. Let us construct a classifier using the basic RBF network, where the radial basis functions are chosen to be multiquadratic type functions

$$\varphi(\|\mathbf{x} - \mathbf{x}_i\|) = [\|\mathbf{x} - \mathbf{x}_i\|^2 + 3]^{1/2}$$

where \mathbf{x}_i is the i :th training vector. Present how the solution is calculated, and form the equations needed for the solution. Note: you do not need to solve these equations numerically.

4. Explain what you know about Deep belief networks. You need not describe their learning algorithms in detail.