Course Artificial Neural Networks - list of questions

Lecture 1

- Explain the difference between digital computers, neural networks and the human brain.

- Explain how neural networks are used within ALVINN.

Lecture 2

- Explain similarities and differences between multilayer perceptron (MLP) and radial basis function (RBF) networks.

- What are advantages or disadvantages of multilayer perceptrons versus polynomial expansions?

- Explain the backpropagation algorithm.

- What is the difference between on-line learning and off-line learning with backpropagation?

- What are the limitations of a perceptron?

- What does Cover's theorem tell us about linear separability?

Lecture 3

- Explain the Newton and Levenberg-Marquardt learning of neural networks.

- Explain quasi-Newton learning of neural networks.

- Explain conjugate gradient learning of neural networks.

- What is the role of a regularization term?

- What is overfitting? How can this be avoided?

- What is the effective number of parameters?

Lecture 4

- What is the difference between least squares and ridge regression? How is this related to the bias-variance trade-off?

- Explain cross-validation.

- Explain complexity criteria.

- Discuss pruning algorithms.

- Explain the committee networks method.

Lecture 5

- Explain the Occam's razor principle.

- What is the difference between parameters and hyperparameters when training multilayer perceptrons?

- What is the role of the prior distribution in Bayesian learning of neural networks?

- What is the difference between the number of parameters and the effective number of parameters?

- How does one characterize uncertainties on predictions in a Bayesian learning framework?

Lecture 6

- What is the working principle of associative memories from a dynamical systems point of view?

- What is the Hebb rule for storing patterns in associative memories and why does it work?

- What is the role of an energy function for associative memories?

- What determines the storage capacity in associative memories?

- When solving the TSP problem using a Hopfield network, how are cities and a tour being represented?

Lecture 7

- How can one do dimensionality reduction using linear principal component analysis and nonlinear principal component analysis?

- What is the reconstruction problem in principal component analysis?

- Explain the working principle of Oja's learning rule.

- What is the aim of vector quantization?

- How is vector quantization related to self-organizing maps?

Lecture 8

- How can a multilayer perceptron be used for time-series prediction?

- How can one use neural networks in different model structures for system identification?

- Explain the use of dynamic backpropagation.

- Explain the use of neural networks for control applications.

Lecture 9

- What are advantages of support vector machines in comparison with classical multilayer perceptrons?

- What is the kernel trick in support vector machines?

- What is a support vector?

- What is a primal and a dual problem in support vector machines?

Lecture 10

- Give motivations for considering the use of more hidden layers in multilayer feedforward neural networks.

- Explain the pre-training and fine-tuning steps when combining an autoencoder with a classifier.

- What are possible difficulties for training deep networks?

- Explain stacked autoencoders.