Neural Computing

Model of Neuron (Haykin, 2nd edition, p.10-23)

Perceptron (Haykin, p.117-120)

Perceptron's learning algorithm (Haykin, p.135-143, 175-178)

Multilayer perceptron (feedforward nets) (Haykin, p.156-161)

Backpropagation (Haykin, p.161-175, 226-232)

Problem of local minimum, adding momentum, etc. (Haykin, p.191-198)

Regularization (Haykin, p.218-222)

Learning evaluation and generalization (Haykin, p.205-209, 213-218)

Self-organising maps (Haykin, p.443-466)

Support Vector Machines (Haykin, p.318-324, 329-339, lecture notes, A. Ng notes)

Hopfield networks (Haykin, p.50-66, 680-696)

Gibbs sampling (Haykin, p.545-550, 561-562)

Boltzmann machines, Generative models (Haykin, p.558-560, 562-574)

Restricted Boltzmann machines (Lecture notes)

Contrastive Divergence (Lecture notes)

Deep learning (Lecture notes)

Recurrent networks (Haykin, p.732-741)

Convolutional nets (lecture notes)

Autoencoders (lecture notes)

Backpropagation through Time (Haykin, p. 751-756, lecture notes)

Neural-symbolic systems (Lecture notes), non-examinable

Example Exam

5 to 7 questions (answer all)
Each question for 10 to 25 marks;
100 marks in total, 120min

Q1) Answer True or False (20 marks):

a) A perceptron is a single layer feedforward neural network
b) A perceptron is an auto-associative neural network
c) A recurrent neural network is a network without any feedback
d) An auto-associative network is a network that contains only one feedback
e) An auto-associative network has the same number of input and output neurons
f) Neural networks are interpretable, i.e. can explain their answers by themselves

Q2)

a) In the network below, calculate output o given (a, b) = (0.7, 0.3) and sigmoid activation function (5 marks)

b) Briefly describe how backpropagation works (10 marks)
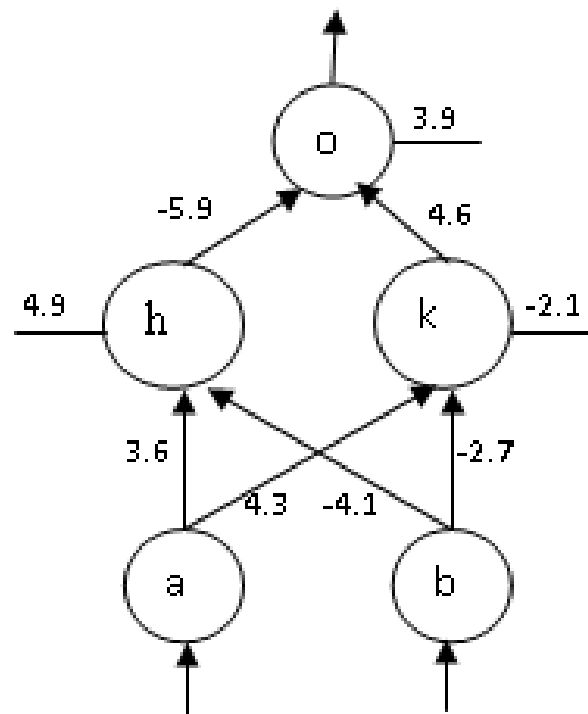
Q3)

Explain why self-organising maps (SOM) can be used for clustering. Give an example of a hybrid system combining SOM and a feedforward neural network (10 marks)

Q4)

Discuss how the number of hidden neurons can influence network learning and network generalisation (10 marks)

NOTE: Discuss = briefly discuss, i.e. 2 paragraphs

Q5)

Consider the following data set where A and B are numerical values and Z is a Boolean (yes/no) classification.

i. Let P be the perceptron with weights wA = 2, wB = 1 and bias -4.5. What is the value of the standard error function for this perceptron on this data set? (10 marks)

ii. Find a set of weights and bias that classifies all the data correctly (10 marks)

A	B	Z
1	2.5	1
2	1.5	0
3	2	1
1	1	0

Q6)

i) What is a deep network? Give an example of deep learning (5 marks)

ii) List the pseudo-code of a Boltzmann machine training algorithm. What is a Boltzmann machine useful for? (10 marks)

iii) Describe how the Contrastive Divergence learning algorithm works (10 marks)