

2001 Paper 9 Question 9

Neural Computing

- (a) (i) Many classes of artificial neural networks learn from data by forming a lower dimensional parametric representation, or mapping, that resembles the process of curve-fitting. Explain this idea in reference to least-squares error minimisation or statistical regression. [4 marks]
- (ii) Explain why increasing the complexity of a model may cause a neural network's error in the training phase to become smaller and smaller, but its generalisation in the validation phase to become worse and worse. How would you expect the optimal complexity of a neural network model to depend on the amount of data? [6 marks]
- (b) Answer *each* of the following short questions:
- (i) What is the approximate capacitance of nerve cell membrane, in microFarads per cm^2 , and what functional parameters of neural activity are determined by this? [2 marks]
- (ii) Approximately what range of voltages does a nerve cell membrane move through during the course of generating a neural impulse, and what determines this range? [2 marks]
- (iii) What is the rôle of positive feedback in nerve impulse generation? [2 marks]
- (iv) From which organ does the retina develop embryologically, and to what cells elsewhere in the body are the retinal photoreceptors most closely related? [2 marks]
- (v) What causes the refractory deadtime of about 1 msec after each nerve impulse, and what is its consequence? [2 marks]