

Indian Statistical Institute

Mid-Semester Examination: 2019 – 2020

Master of Science in Quality Management Science, Semester II

Compulsory Optional: Neural Networks

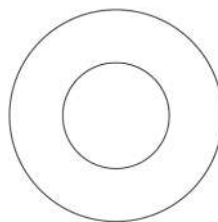
Date: 5 March 2020

Maximum Marks: 50

Duration: 2 hours

Attempt all the questions. Credit will be given for precise and brief answers.

1. What is supervised learning and what is unsupervised learning? Present one example of each with reason. What is over fitting and what is under fitting? Show that in case of linearly separable data sets concerns of over fitting and under fitting become immaterial, but even for slightly nonlinearly separable data sets these two notions become important concerns. 2 + 4 + 2 + 4 = 12
2. (a) The number of input and output nodes in an artificial neural network (ANN) is fixed, but number of hidden nodes and connection weights are not. They are called free parameters of an ANN. "If there are too few free parameters the network will not be able to learn the training set well enough. If there are too many of them the network will not generalize." Please explain the statement within the double quote. 6
(b) Write a short note on Hopfield network. 6
3. (a) Consider the following configuration in a two dimensional space. If a neural network is designed to identify this configuration at the least how many hidden layers the neural network must have and why? 5



- (b) Define Hebbian learning rule. Come up with a mathematical formulation of the Hebbian learning rule (credit will be given for your own innovative formulation) and justify why it should work. 2 + 2 + 3 = 7
4. Define ADALINE and MADALINE networks with a diagram of the architecture for each. Imagine a circuit, in which there are 5 parallel resistors of 5 ohm each. So, the resistance of the circuit is 1 ohm. If at least 3 of them work, then the resistance of the circuit is 1.67 ohm or less. If the circuit is considered broken for resistance greater than 1.67

ohm, design a MADALINE neural network which will be able to switch on/off the circuit by switching on/off the resistors subject to certain conditions, which may be taken as input. The input conditions do not need to be mentioned here. They may be arbitrary.

$$2 + 4 + 6 = 12$$

5. Mention two drawbacks of the Principal Component Analysis (PCA) algorithm. 2