Course Code: CCS 420

Credit Units 3

Pre-requisite: CCS 329

Purpose of the Course

The course introduces the theory and practice of neural computation. It offers the principles of neurocomputing with artificial neural networks widely used for addressing real-world problems such as classification, regression, pattern recognition, data mining, time-series prediction

Expected Learning Outcomes

On completion of this module the students shall be able to:

1. Explain the differences between networks for supervised and unsupervised learning;
2. Explain the behavior of radial-basis function networks;
3. Demonstrate an understanding of training of recurrent Hopfield networks.
4. Design single and multi-layer feed-forward neural networks.

Course Content

Biological inspiration: Brain metaphor of computation versus stored program computation. Simplified description of the structure and behavior of a typical spiking biological neuron. Interpretation of the structure and behavior of a spiking neuron from an engineering perspective. Mathematical concepts: Vector spaces. Inner-product spaces. Metric spaces. Limiting functions: hard-threshold functions, piece-wise linear functions and sigmoid functions. Bump functions. Wavelets. Mutivariate calculus. Artificial neuron models: Excitation functions. Activation functions. Perceptrons. Radial basis function (RBF) cells. Polynomial function cells. Neural network structures: Feedforward structures. Recurrent structures. Lattice structures. Learning process: Paradigms of learning: supervised learning, reinforcement learning and unsupervised learning. Learning algorithms: Hebbian learning, perceptron learning rule, error-correcton learning, competitive learning and Boltzmann learning. Feedforward artificial neural networks (ANNs): Limitations of single cells. Single layer networks. Multilayer perceptron (MLP) networks. RBF networks. Support vector machine (SVM) networks. Committee machines. Feedforward associative networks. Recurrent ANNs: Hopefield networks. Brain-state-in-a-box (BSB) networks. Adaptive resonance theory (ART) networks. Classic lattice networks: Self-organizing maps. Adaptive vector quantization (AVQ) networks. Applications: Pattern recognition. Signal processing. System control.

Laboratory component: 3 hours per week.

Mode of delivery

Lectures, directed reading, practical demonstrations of typical computing systems.

Course Assessment	Type	Weighting (%)
	Examination	70
	Continuous Assessment	30
	Total	100

Core Reading Material for the course

1. "Neural Networks and Learning Machines," Haykin and Simon, Pearson Higher Education, ISBN, 978-0131471399
2. "Neural Networks. A Comprehensive Foundation," Second Edition, Haykin and Simon, ISBN Prentice-Hall 0-262-02417-9
3. "

they are employed unconsciously by authors (Anwar et al., 2019; Castro-Castro et al., 2019.; Sari, 2018; Koppel & Schler, 2004). An overview of most frequently used syntactic features is given in table 1.2.

Table 1. 2: List of Syntactic Features

Feature Type	Examples
Syntactic Features	Part of speech tags
	Punctuations
	Functional words
	Verbal phrases
	Frequencies of part of speech pair
	Frequencies of Punctuations
	Punctuational Frequency
	Syntactically classified punctuation
	Frequency of word pairs
	Stop words

Structural features are used to define the general document organization by individual authors (Elmanarelbouanani & Kassou, 2014). They include features like length of sentences in a