GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Syllabus

Subject Code : 3154601

Subject Name : Fundamentals of Neural Networks

WEF Academic Year :	2022 - 23
Semester :	5
Category of the Course :	Professional Elective

Prerequisite :	Linear Algebra, Probability.
Rationale :	Artificial Neural Networks take their cues from the human brain while designing their computational models. Pattern recognition, speech recognition, robotics, etc. are only a few examples of current AI developments made possible by ANN. ANN are computer simulations that mimic biological processes in order to carry out a wide variety of tasks, including clustering, classification, pattern recognition, etc. The ANN is a powerful model with potential applications in both problem solving and automated learning. As a result, they are both adaptable and potent because of how they learn.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**INRODUCTION TO NEURAL NETWORKS :** History of development of neural network, Biological neurons and artificial neurons, Model of an ANN, Activation functions, Classes of network architectures, supervised and unsupervised learning rules, Knowledge representation, Neural Network applications.	8	20
2	**LEARNING IN NEURAL NETWORKS :** Vector and matrix algebra, State-space concepts, Concepts of optimization, Error-correction learning, Memory-based learning, Hebbian learning, Competitive learning, Delta learning rule, Windrow-Hoff learning rule.	8	20
3	**SINGLE LAYER PERCEPTRONS :** Structure of perceptron, Learning in perceptron, perceptron as classifier, introduction and Bayes' classifiers, Perceptron convergence. Limitations of a perceptron.	8	20

4	**FEEDFORWARD NEURAL NETWORKS :** Feedforward ANN, Single layer feedforward network, Multi-layer feedforward networks, Working of Backpropagation algorithm, Functional approximation with backpropagation. Practical and design issues of backpropagation learning.	8	20
5	**SELF-ORGANIZING NETWORKS :** Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Pattern Classification Korhonen algorithm, Hopfield Networks: Hopfield network algorithm, Adaptive resonance theory: Network and learning rules.	6	15
6	**ADVANCED NEURAL NETWORKS :** Radial Basis Functions, Support Vector Machines, Principle component Analysis, Deep Learning.	4	10
	Total		**100**

Reference Book :

- Simon O. Haykins, “Neural Networks: A Comprehensive Foundation”, 2nd Edition, Pearson 1994.
- B. Yegnanarayana, “Artificial neural network”, PHI Publication.
- S. Raj sekaran, Vijayalakshmi Pari, “Neural networks, Fuzzy logic and Genetic Algorithms”, PHI Publication.
- Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
- James A Freeman and David M.Skapra, “Neural Networks: Algorithms, Applications, and Programming Techniques”, Addison-Wesley, 1991, Digital Version 2007.
- Laurene Fausett, “Fundamentals of Neural Networks: Architecture, Algorithms, and Applications”, Prentice Hall.

Course Outcome :

After Completion of the Course, Student will able to :

No.	Course Outcomes	RBT Level*
01	Describe the neural network architecture and learning algorithms.	RM
02	Understand various learning mechanism in neural network.	UN
03	Understand single and multilayer neural network architecture.	AP
04	Develop an algorithm using neural network for different fields.	AP
05	Differentiate various types of neural networks.	AN

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List :

1. Study basic functions related to neural network in MATLAB/python.
2. Write a program to perform basic matrix multiplications.
3. Write a program to implement Perceptron.
4. Write a program to implement Multilayered feedforward neural Network.
5. Implement Binary Classification Using neural network.
6. Implement Multi-Class Classification using Neural network.
7. Write a program to implement Classification using Back-Propagation.
8. WAP to test the effect of weight, bias and activation function in neural network.
9. Load Iris flower dataset and implement multilayer neural network to classify the flowers.
10. Load breast cancer dataset and analyze the performance of neural network against various learning methods.

List of Laboratory/Learning Resources Required :

https://victorzhou.com/blog/intro-to-neural-networks/
https://serokell.io/blog/neural-networks
https://theneuralblog.com/
https://www.v7labs.com/blog/neural-network-architectures-guide
https://www.freecodecamp.org/news/building-a-neural-network-from-scratch/
https://realpython.com/python-ai-neural-network/
https://natureofcode.com/book/chapter-10-neural-networks/

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