

III- Year I- Semester	Name of the Course	L	T	P	C
Course Code: 20CM5P01	Artificial Neural Networks (Professional Elective - 1.1)	2	0	2	3

Course Objectives:

1. To learn data processing and cleaning
2. To understand mathematical model of artificial neuron
3. To learn various activation functions used in neural network
3. To understand training and learning process in neural networks
4. To implement neural network models using python

Syllabus:

Unit-1: Foundations

Linear Algebra- Creating matrices add vectors using NumPy, implementation of operations on matrices-addition, subtraction, multiplication, transpose, inverse, determinant, Vectors- addition, subtraction, dot product, various norms. Linear transformations, pre-processing data using pandas. Scikit Learn-data processing, creating model using scikit-learn.

Unit-2: Introduction to Artificial Neural Network

Biological Model of Neuron, ANN model, McCulloch and Pitts model, Adaline, Perceptron, Activation functions, realizing logic gates using perceptron, implementing perceptron using Python, implementing functionality of logic gates using perceptron in python.

Unit-3: Single Layer Perceptron

Architectural Models for ANN, Single Layer Perceptron Perceptron as a classifier, implementing classification using perceptron, Learning and training ANN, optimization- Gradient descent algorithm, stochastic gradient descent algorithm, implementation of gradient descent using python.

Unit-4-Multilayer Perceptron

Multilayer Perceptron- architecture, functionality of neurons in different layers, implementing multilayer perceptron using scikit-learn, Back propagation algorithm-training and convergence, design issues, example, implementation using python.

Unit-5- Linear, Logistic regression and Classification

Linear and logistic regression using MLP, multivariate regression, implementation of linear and logistic regression using scikit-learn, Function Approximation using

MLP, RBF networks, RBF Training. Implementation of classification using ANN with scikit-learn on IRIS dataset.

Text Books:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Pradhan Manaranjan , U Dinesh Kumar, "Machine Learning Using Python" , wiley.

References:

1. Yegna narayana B, "Artificial Neural Networks", PHI Learning Pvt. Ltd, 2009.
2. Martin T. Hagan, Howard B. Demuth, Mark Hudson Beale, Orlando De Jesús, NeuralNetwork Design, 2nd Edition (Free Online version available at url 4)
3. Aurélien Géron, Neural networks and deep learning, O'Reilly Media, 2018.

Web Resources:

1. <https://numpy.org/doc/stable/user/quickstart.html>
2. https://pandas.pydata.org/docs/user_guide/index.html
3. https://scikit-learn.org/stable/modules/neural_networks_supervised.html
4. <https://towardsdatascience.com/data-preprocessing-with-python-pandas-part-1- missing-data-45e76b781993>
5. <https://hagan.okstate.edu/NNDesign.pdf>
6. <https://nptel.ac.in/courses/117105084>
7. <https://nptel.ac.in/courses/108108148>
8. <https://nptel.ac.in/courses/106105152>

Course Outcomes: By the end of the course the student will be able to

- Perform data pre processing.
- Able to implement mathematical model of neural network using python.
- Implement training process using training data.
- Improve accuracy and performance by tuning parameters.
- Classify data using neural network models

CO-PO Mapping Matrix:

[illegible]

Micro Syllabus : Artificial Neural Networks

Unit-1: Linear Algebra- Creating matrices add vectors using numpy, implementation of operations on matrices-addition, subtraction, multiplication, transpose, inverse, determinant, Vectors- addition, subtraction, dot product, various norms. Linear transformations, pre processing data using pandas. Scikit Learn-data processing, creating model using scikit-learn.

Unit No.	Topic	Sub Topic
I	Linear Algebra	Creating matrices add vectors using numpy
		Implementation of operations on matrices-addition, subtraction, multiplication, transpose, inverse, determinant.
		Implementation of operations on vectors- addition, subtraction, dot product, various norms.
		Linear transformations-system of linear equations, representation in matrices and vector form.
	Pandas	pre processing data using pandas-dealing with missing values, data standardization ,data normalization.
	Scikit-Learn	Scikit-Learn introduction
		Scikit-Learn functions to implement Perceptron, Multilayer Perceptron.
		Functions to implement regression in Scikit-Learn

Unit-2: Introduction to Artificial Neural Network, Biological Model of Neuron, ANN model, McCulloch and Pitts model, Adaline, Perceptron, Activation functions, Realizing logic gates using perceptron, Implementing perceptron using Python, implementing functionality of logic gates using perceptron in python.

II	Artificial Neural Network	Introduction to Artificial Neural Network
		Biological Model of Neuron-functionality of building blocks.
		ANN model-Mathematical model.
		Example Models- McCulloch and Pitts model, Adaline, Perceptron.
		Activation Functions-linear, threshold, sigmoid ,tanh, relu, leaky relu, softmax.
		Realizing logic gates using perceptron-AND, OR, XOR.
	Perceptron Implementation	Perceptron implementation using python.
		Implementing logical gates using perceptron.

Unit-3: Architectural Models for ANN, Single Layer Perceptron, Perceptron as a classifier, implementing classification using perceptron, Learning and training ANN, optimization- Gradient descent algorithm, stochastic gradient descent algorithm, implementation of gradient descent using python.

Unit No.	Topic	Sub Topic
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III	Single Layer Perceptron	Architectural Models for ANN- Single layer feed forward, Multi layer feed forward, Recurrent neural network.
		Single Layer Perceptron- mathematical model and building blocks.
		Classification using perceptron, drawbacks.
		Implementing classification using perceptron using python, Scikit-Learn.
		Learning and training process in ANN- learning definition, learning in ANN.
	Optimization Techniques	Optimization- constrained and unconstrained optimization introduction.
		Gradient Descent algorithm.
		Stochastic gradient descent algorithm.
implementation of gradient descent using python.		
Unit-4: .Multi layer Perceptron- architecture, functionality of neurons in different layers, implementing multi layer perceptron using scikit-learn, Back propagation algorithm-training and convergence, design issues, example, imeplementation using python.		
Unit No.	Topic	Sub Topic
IV	Multi layer Perceptron	Architecture of multi layer prceptron
		Functionality of neurons in different layers in multi layer perceptron.
		Implementing multi layer perceptron using scikit-learn.
	Back Propagation Algorithm	Training and convergence- error computation, cost function, derivations of cost functions at different layers, algorithm.
		Design issues- practical design issues.
		Simple example of back propagation algorithm.
		Implementation of Back Propagation using Python.
Unit-5: Linear and logistic regression using MLP, multivariate regression, implementation of linear and logistic regression using scikit-learn, Function Approximation using MLP, RBF networks, RBF Training. Implementation of classification using ANN with scikit-learn on IRIS dataset.		
Unit No.	Topic	Sub Topic
V	Multi layer Perceptron	Linear and logistic regression using MLP.
		Multivariate regression using MLP.
		Implementation of linear and logistic regression using scikit-learn
		Function Approximation using MLP.
	RBF Networks	Radial Basis Function Networks- structure, functionality of neurons.
		XOR Problem.
		RBF Training.
	Practical Implementation	Implementation of classification using ANN with scikit-learn on IRIS dataset.

