Course Handout

Semester: VII
Academic Year: 2019-20
Course Code: CS342
Course Title: Artificial Neural Network
LTPC: 3104
Programme: Bachelor of Technology
Course-in-charge: Dr. Prashant Srivastava

1. Course Description

- This course is an introduction to Artificial Neural Networks.
- It will focus on the computational fundamentals of artificial neural networks and their applications.

2. Course Content

- Introduction to Artificial Neural Networks
- Artificial Neuron Model and Linear Regression
- Gradient Descent Algorithm
- Nonlinear Activation Units
- Learning Mechanisms-Hebbian
- Competitive Analysis
- Boltzmann Analysis
- Associative Memory Model
- Condition for Perfect Recall in Associative Memory
- Statistical Aspects of Learning
- Single-Layer Perceptions
- Unconstrained Optimization: Gauss-Newton's Method
- Linear Least Squares Filters
- Least Mean Squares Algorithm
- Perceptron Convergence Theorem
- Bayes Classifier & Perceptron: An Analogy
- Bayes Classifier for Gaussian Distribution
- Back Propagation Algorithm
- Practical Consideration in Back Propagation Algorithm
- Solution of Non-Linearly Separable Problems Using MLP
- Heuristics For Back-Propagation

- Multi-Class Classification Using Multi-layered Perceptions
- Radial Basis Function Networks: Cover's Theorem, Separability & Interpolation
- Radial Basis Function Networks
- Posed Surface Reconstruction
- Solution of Regularization Equation: Greens Function
- Regularization Networks and Generalized RBF
- Comparison Between MLP and RBF
- Learning Mechanisms in RBF
- Introduction to Principal Components and Analysis
- Introduction to Self-Organizing Maps
- Cooperative and Adaptive Processes in SOM
- Vector-Quantization Using SOM

3. Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand various concepts of ANN
CO2	Understand the mathematical background of ANN
CO3	Learn to write basic algorithms for implementing ANN
CO4	Learn to develop applications of neural networks to solve various computational and research problem

4. Course Outcomes Mapping with Programme Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	H	H	H	H	M	L	L	L	L	L	L	H	H	H	H
CO2	H	H	H	H	M	L	L	L	L	L	L	H	H	H	H
CO3	H	H	H	H	H	H	H	L	L	L	L	H	H	H	H
CO4	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H

Note: H- High**, M**- Moderate**, L**- Low and **NA**- Not Applicable

5. Session Plan

Sl. No.	Topics	No. of Lectures	Course Outcome
1	Introduction to Artificial Neural Networks	2	CO1, CO2, CO3
2	Artificial Neuron Model and Linear Regression	2	CO1, CO2, CO3
3	Gradient Descent Algorithm	1	CO1, CO2, CO3, CO4
4	Nonlinear Activation Units	1	CO1, CO2, CO3, CO4
5	Learning Mechanisms-Hebbian	2	CO1, CO2, CO3, CO4
6	Competitive Analysis	1	CO1, CO2, CO3, CO4
7	Boltzmann Analysis	1	CO1, CO2, CO3, CO4
8	Associative Memory Model	1	CO1, CO2, CO3, CO4
9	Condition for Perfect Recall in Associative Memory	1	CO1, CO2, CO3, CO4
10	Statistical Aspects of Learning	2	CO1, CO2, CO3, CO4
11	Single-Layer Perceptions	1	CO1, CO2, CO3, CO4
12	Unconstrained Optimization: Gauss-Newton's Method	1	CO1, CO2, CO3, CO4
13	Linear Least Squares Filters	1	CO1, CO2, CO3, CO4
14	Least Mean Squares Algorithm	1	CO1, CO2, CO3, CO4
15	Perceptron Convergence Theorem	1	CO1, CO2, CO3, CO4
16	Bayes Classifier & Perceptron: An Analogy	1	CO1, CO2, CO3, CO4
17	Bayes Classifier for Gaussian Distribution	1	CO1, CO2, CO3, CO4
18	Back Propagation Algorithm	2	CO1, CO2, CO3, CO4
19	Practical Consideration in Back Propagation Algorithm	1	CO1, CO2, CO3, CO4
20	Solution of Non-Linearly Separable Problems Using MLP	1	CO1, CO2, CO3, CO4
21	Heuristics for Back-Propagation	1	CO1, CO2, CO3, CO4
22	Multi-Class Classification Using Multi-layered Perceptions	1	CO1, CO2, CO3, CO4
23	Radial Basis Function Networks: Cover's Theorem, Separability & Interpolation	1	CO1, CO2, CO3, CO4
24	Radial Basis Function Networks	1	CO1, CO2, CO3, CO4
25	Posed Surface Reconstruction	1	CO1, CO2, CO3, CO4
26	Solution of Regularization Equation: Greens Function	2	CO1, CO2, CO3, CO4
27	Regularization Networks and Generalized RBF	1	CO1, CO2, CO3, CO4
28	Comparison Between MLP and RBF	1	CO1, CO2, CO3, CO4
29	Learning Mechanisms in RBF	1	CO1, CO2, CO3, CO4
30	Introduction to Principal Components and Analysis	1	CO1, CO2, CO3, CO4
31	Introduction to Self-Organizing Maps	2	CO1, CO2, CO3, CO4
32	Cooperative and Adaptive Processes in SOM	1	CO1, CO2, CO3, CO4
33	Vector-Quantization Using SOM	1	CO1, CO2, CO3, CO4
Total		**40**	

6. Evaluation Scheme

Mid Semester – I	Pen-Paper	1 Hour	20%	Closed Book
Mid Semester – II	Pen-Paper	1 Hour	20%	Closed Book
Comprehensive Exam	Pen-Paper	2 Hours	30%	Closed Book
Attendance	-	-	10%	-
Project	Offline	-	20%	-

7. Course Outcomes Mapping with Evaluation Components

Course Outcomes	Mid-Sem I	Mid-Sem II	Comprehensive Exam	Project
CO1	H	H	H	H
CO2	H	H	H	H
CO3	H	H	H	H
CO4	H	H	H	H

H- High**, M-** Moderate**, L-** Low and **NA-** Not applicable

8. Project

Students will be required to make a project based on the concepts studied in theory classes. The project will be of 20% marks. The detailed evaluation of the project will be done as follows:

- Project work 12% marks
- Presentation 5% marks
- Project report 3% marks

Students will have to give a presentation of their project which would be of 10 minutes showing the work done in the project and the output achieved. The dates of final presentation will be announced by Course-in-charge. However, the final presentation is expected to take place one week before comprehensive examination.

9. Attendance Policy

As per Attendance policy of the University.

10. Make up Policy

Students who are likely to miss a component of evaluation on a genuine reason may be given a make-up of that component by the Course In-Charge. The students are required to approach Course In-Charge immediately for the same before the conduct of the evaluation component. It is

the responsibility of the student to approach the Course In-Charge. The Course In-Charge will not allow makeup, if student approaches 7 days after the examination.

11. Plagiarism

Instances of plagiarism will be dealt with in accordance with the rules set by the University in this connection.

12. Grading Policy

Marks obtained in all the components of evaluation shall be summed up and the final marks shall be converted in the letter grades, namely, A, B, C, D, E and as per University policy. The grading is relative and normally it is centered around the average of a class. Mid-semester grading will be announced on completion of about 50% of the evaluation components.

13. Pedagogy

MS-PowerPoint Presentations, Videos and Animation of few lectures, as well as Open Course Ware websites will be used as teaching methodologies.

14. Text Books

TB1. Simon Haykin, Neural Networks - a Comprehensive Foundation, Prentice Hall, 2nd Edition, 1999.

TB2. Mohamad Hassoun, Fundamentals of Artificial Neural Networks. A Bradford Book, 2003.

14. Reference Books

RB1. Jeff Heaton, Introduction to the Math of Neural Networks, Heaton Research Inc., 2012.

RB2. J. A. Freeman and D. M. Skapura, Neural Networks- Algorithms, Applications and Programming Techniques, Pearson Education, 1st Edition, 2002 .

15. Consultation Hour

By prior appointment fixed via email: write to: Prashant.Srivastava@niituniversity.in