

## Elective- IV SOFT COMPUTING (ICS 806)

Teacher Name:

Mr. Indresh Gupta

Course Structure

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3	1	0	4

Prerequisite: Artificial Intelligence (ECS-401)

Course Content:

### Unit 1: Introduction to Intelligent Systems and Soft Computing

Characteristic behavior of Intelligent systems, Knowledge based systems, Knowledge Representation and Processing, Soft Computing characteristics, Constitutes of Soft Computing-Fuzzy Logic and Computing, Neural Computing, Evolutionary Computing, Rough Sets, Probabilistic Reasoning and Machine Learning.

### Unit 2: Neuro Computing - Supervised Learning

Biological background, Pattern recognition tasks, Features of artificial neural networks, Activation functions, Perceptron model, Perceptron for classification and its limitations, Architectures of multilayer feed-forward neural networks, Back-propagation learning algorithm, Limitations of MLP.

### Unit 3: Neuro Computing - Unsupervised Learning

Hebb's learning rule for competitive learning, Kohonen's self-organizing map and network topology, applications of SOM, Hopfield network and its topology, Boltzman Machines, Adaptive Resonance Theory.

### Unit 4: Fuzzy Logic and Fuzzy Systems

Evolution of fuzzy logic, fuzzy sets, fuzzy logic operations, fuzzy relations, Fuzzy arithmetic and fuzzy measures. Fuzzy rules and reasoning, Fuzzy inference systems, Fuzzy modeling and decision making, Neuro-fuzzy modeling.

### Unit 5: Evolutionary Computing

Biological background and Overview of evolutionary computing, Genetic algorithm and search space, Operators in genetic algorithm- encoding, selection, crossover, and mutation, Classification of GA, Evolutionary Programming and Strategies, Applications of fuzzy in pattern recognition-character recognition. Applications of evolutionary computing in Image processing and computer vision, applications of Soft computing in mobile ad-hoc networks, Information Retrieval, Semantic web, and Software Engineering.

### **Text and Reference Books:**

1. Fakhreddine O. Karray, Clarence De Silva, 'Soft Computing and Intelligent systems design' Pearson Education, ISBN 978-81-317-2324-1.
2. B. K. Tripathy, J. Anuradha, 'Soft Computing: advances and applications', Cengage learning, ISBN-13: 978-81-315-2619-4.
3. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley publications, 2nd Edition.
4. J. S. R. Jang, C. T. Sun, E. Mizutani, 'Neuro-Fuzzy and Soft Computing- A computational approach to Learning and Machine Intelligence' PHI.
5. David E. Goldberg, Genetic Algorithms - Pearson Education, 2006.
6. Satish Kumar, "Neural Networks - A Classroom Approach", Tata McGraw-Hill.

### **Course Outcomes:**

1. Understand differential behavior of Human and Intelligent Systems. (Understand)
2. Understand and use supervised and un-supervised learning techniques in ANN. (Understand)
3. Understand and apply different soft computing techniques like Genetic Algorithms, Fuzzy Logic, Neural Network and their combination. (Understand, Apply)
4. Correlate human-like processing in problem solving with current technologies in various domains like Bio Informatics, Multimedia Systems, Big Data Analytics, etc.
5. Apply evolutionary computing techniques in real life problems. (Apply)

### **Lecture Plan**

<b>S.No.</b>	<b>Name of Topic</b>	<b>No. of lectures taken</b>
1.	Introduction to soft computing, Basic concepts - Single layer perception - Multilayer Perception	3
2.	Supervised and Unsupervised learning	1
3.	Back propagation networks	1
4.	Kohonen's self organizing networks	1
5.	Hopfield network	1
6.	Fuzzy sets and Fuzzy reasoning	2
7.	Fuzzy matrices	2
8.	Fuzzy functions	2
9.	Decomposition – Fuzzy automata and languages	1
10.	Fuzzy control methods - Fuzzy decision making	1
11.	Adaptive networks based Fuzzy interface systems	1
12.	Classification and Regression Trees	1
13.	Data clustering algorithms	2
14.	Rule based structure identification	1
15.	Neuro-Fuzzy controls	1
16.	Simulated annealing, Evolutionary computation	1
17.	Survival of the Fittest - Fitness Computations	2
18.	Crossover, Mutation	2
19.	Reproduction – Rank method - Rank space method.	2
20.	AI search algorithm	2
21.	Predicate calculus	2
22.	Rules of inference	1
23.	Semantic networks - Frames - Objects - Hybrid models - Applications.	2

## Assignments

### ASSIGNMENT -1

#### SOFT COMPUTING (ICS-810)

**Last Date of Submission: 26-1-2019**

Q.1 Calculate the net input for network shown in Figure 1. With bias included in the network.

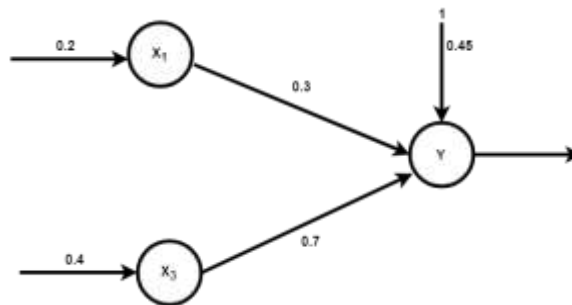


Figure 1

Q.2 Implement ANDNOT function using McCulloch-Pitts neuron (use binary data representation).

Q.3 Design a Hebb network to implement OR function (consider bipolar inputs and targets).

Q.4 Find the weights required to perform the following classification using perceptron network. The vectors  $(1,1,1,1)$  and  $(-1,1,-1,-1)$  are belonging to the class (so have target value 1), vectors  $(1,1,1,-1)$  and  $(1,-1,-1,1)$  are not belonging to the class (so have target value -1). Assume learning rate as 1 and initial weight as 0.

Q.5 Explain perceptron training algorithm for multiple output classes in detail.

### ASSIGNMENT -2

#### SOFT COMPUTING (ICS-806)

**Last Date of Submission: 17-2-2019**

Q.1 Train the auto associative network for input vector  $[-1 \ 1 \ 1 \ 1]$  and also test the network for the same input vector. Test the auto associative network with one missing, one mistake, two missing and two mistake entries in one test vector.

Q.2 Construct an auto associative network to store vectors  $[-1 \ 1 \ 1 \ 1]$ . Use iterative auto associative to test the vector with three missing elements.

Q.3 Train a heteroassociative network to store the given bipolar input vector  $s = (s_1 \ s_2 \ s_3 \ s_4)$  to the output vector  $t = (t_1 \ t_2)$ . The bipolar vector pairs are given in Table

	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	t <sub>1</sub>	t <sub>2</sub>
1 <sup>st</sup>	1	-1	-1	-1	-1	1
2 <sup>nd</sup>	1	1	-1	-1	-1	1
3 <sup>rd</sup>	-1	-1	-1	1	1	-1
4 <sup>th</sup>	-1	-1	1	1	1	-1

Q.4 Explain the fuzzy expert system with help of suitable block diagram.

Q.5 Suppose 100 people record the questionnaire about their pairwise preference among five cars X={Maruti 800, Scorpio, Martiz, Santro, Octavia} Define a fuzzy set A on the universe of cars "best car."

### ASSIGNMENT -3

#### SOFT COMPUTING (ICS-806)

**Last Date of Submission: 28-3-2019**

Q.1 What are the key difference between genetic algorithm and traditional optimization techniques?

Q.2 Explain the following selection operators: random selection, roulette wheel selection, rank selection and tournament selection.

Q.3 Explain different steps of genetic algorithm with a flow chart.

Q.4 Consider the problem of maximizing the function:

$$f(x) = x^2$$

Where x is permitted to vary between 0 to 31, how you will solve this problem using GA.

Q.5 what do you mean by term "Random Search", explain it in brief?

## ASSIGNMENT -4

### SOFT COMPUTING (ICS-806)

**Last Date of Submission: 25-4-2019**

Q.1 Explain A\* algorithm in detail and what are key difference between A\* algorithm and dijkshtra algorithm.

Q.2 Explain Breadth first search and Depth first search algorithm in detail.

Q.3 What are the frames? How will you use frames for knowledge representation?

Q.4 Discuss the validity of following Arguments:

All graduates are educated.

Ram is a graduate.

Therefore, Ram is educated.

Q.5 Discuss the validity of following argument:

All integer are irrational number.

Some integers are power of 2.

Therefore, some irrational number is a power of 2.