

## **Lectures for the course: Soft Computing Applications (IT 60108)**

### **Week 1**

#### **Lecture 1 – 31/12/2008**

- Introduction to the course
- What is soft computing
- Evaluation Criteria

#### **Lecture 2 – 01/01/2009**

- Crisp Sets – Definition, Characteristic function
- Fuzzy Set - Definition
- Membership function
- Non-ordered and ordered discrete universe
- Continuous universe
- Examples of fuzzy set

### **Week 2**

#### **Lecture 3 – 05/01/2009**

- Fuzzy Set Membership functions
- Types of membership functions
- Representation of fuzzy sets
- Linguistic variables and values

#### **Lecture 4 – 06/01/2009**

- Support, Core, Normality
- Crossover Points
- Fuzzy Singleton
- $\alpha$  -cut and strong  $\alpha$ -cut
- Convexity

#### **Lecture 5 – 07/01/2009**

- Bandwidth, Symmetry, Left-open, Right-open and Closed
- Subset
- Union, Intersection
- Complementation
- Identities

### Week 3

#### **Lecture 6 – 12/01/2009**

- Identities revisited
- Cartesian Product
- Types of MFs
- Triangular and Trapezoidal

#### **Lecture 7 – 13/01/2009**

- Gaussian MF
- Bell MF
- Sigmoidal MF

#### **Lecture 8 – 14/01/2009**

- 2D Fuzzy Membership Functions
- Cylindrical Extensions
- Projections
- Composite MFs
- Min and Max Compositions

#### **Lecture 9 – 15/01/2009**

- General Complementation Function
- Sugeno's and Yager's complements

### Week 4

#### **Lecture 10 – 19/01/2009**

- Generalized T-norms and conorms
- Generalized DeMorgan's Law

#### **Lecture 11 – 20/01/2009**

- Extension principle
- Fuzzy sets induced by crisp functions

#### **Lecture 12 – 21/01/2009**

- Binary Fuzzy Relations
- Composition of fuzzy relations
- Max-min and max-product compositions

### **Lecture 13 – 22/01/2009**

- Linguistic variables, Term Sets, Linguistic hedges
- Concentration and Dilation
- Contrast Intensification
- Orthogonality

### **Week 5**

### **Lecture 14 – 27/01/2009**

- Fuzzy IF THEN Rules
- Interpretation of fuzzy implication
- Implication functions

### **Lecture 15 – 28/01/2009**

- Class Test 1 held

### **Lecture 16 – 29/01/2009**

- Compositional Rule of Inference
- Fuzzy Reasoning
- Single Antecedent Single rule

### **Week 6**

### **Lecture 17 – 02/02/2009**

- Single Antecedent Multiple rules
- Multiple Antecedent Multiple rules
- Class test scripts shown

### **Lecture 18 – 03/02/2009**

- Mamdani fuzzy systems
- Defuzzification procedures

### **Lecture 19 – 04/02/2009**

- Example of Mamdani fuzzy system

### **Lecture 20 – 05/02/2009**

- Sugeno fuzzy system
- Tsukamoto fuzzy system

## **Week 7**

### **Lecture 21 – 09/02/2009**

- Fuzzy Information Retrieval

### **Lecture 22 – 10/02/2009**

- Fuzzy c-means Clustering

### **Lecture 23 – 11/02/2009**

- Fuzzy Image Processing
- Image contrast intensification

### **Lecture 24 – 12/02/2009**

- Introduction to Optimization
- Overview of GA
- Selection, Crossover and Mutation

## **Week 8**

### **Lecture 25 – 16/02/2009**

- GA – contd.
- Use of GA in coding real numbers with finite precision
- Function of two variables
- Mapping minimization problems to GA
- Example function minimization

### **Lecture 26 – 17/02/2009**

- Functions of multiple variables
- Different types of selection operations

### **Lecture 27 – 18/02/2009**

- Other types of selection operation
- Multi-point crossover
- Mutation revisited

## **Lecture 28 – 19/02/2009**

- No class due to mid-sem exam

## **Week 9**

23/02/2009 – 27/02/2009 Mid sem exam

## **Week 10**

**02/03/2009**

- No Class due to mid-sem exam

## **Lecture 29 – 03/03/2009**

- Constrained GA
- Multi-objective GA
- Pareto-optimality

## **Lecture 30 – 04/03/2009**

- Mid-sem scripts shown
- VEGA
- Dominated solutions

## **Lecture 31 – 05/03/2009**

- MOGA – Goldberg's approach
- MOGA – Fonseca and Fleming's approach

## **Week 11**

## **Lecture 32 – 09/03/2009**

- Introduction to SA
- Metropolis algorithm

## **Lecture 33 – 12/03/2009**

- Complete SA algorithm
- Example

## **Week 12**

**Lecture 34 – 16/03/2009**

- Introduction to PSO

**Lecture 35 – 17/03/2009**

- PSO details

**Lecture 36 – 18/03/2009**

- Introduction to neural networks
- Supervised and unsupervised learning
- Multilayer perceptrons

**Lecture 37 – 19/03/2009**

- Training an MLP
- Backpropagation Algorithm

**Week 13**

**Lecture 38 – 24/03/2009**

- Application in Pattern recognition domain
- Hough transform for line and circle detection
- Formation of feature vectors

**Lecture 39 – 25/03/2009**

- Extraction of fuzzy feature vectors from Hough transform
- Fuzzy MLP output

**Lecture 40 – 26/03/2009**

- Genetic algorithm for feature selection

**Week 14**

**Lecture 41 – 06/04/2009**

- Unsupervised Learning Neural Networks
- Competitive Learning

**Lecture 42 – 08/04/2009**

- Kohonen Self Organizing Maps

**Lecture 43 – 09/04/2009**

- LVQ1 and LVQ2

**Week 15**

**Lecture 44 – 13/04/2009**

- Clarifications on topics requested by the students
- Feedback

**Lecture 45 – 13/04/2009 (afternoon)**

- Term Project Seminar

**Lecture 46 – 15/04/2009**

- Term Project Seminar