

# Soft Computing Applications (CS60108)

Dr. Debasis Samanta

**04 January, 2024**

# Class Organization

Semester : Spring, Session 2023-2024

Course : **Soft Computing Applications**

Code : CS 60108

Credit : 4-0-0 = 4

Slot : **D**

Timing : Monday 12:00 PM - 12:55 PM

: Tuesday 10:00 AM - 11:55 AM

: Thursday 08:00 AM - 08:55 AM

Class Room : *CSE Seminar Room, Takshashila Building*

# Course Plan

- 1. Introduction to Soft Computing**
- 2. Evolutionary Computing**
  - ▶ Genetic Algorithms (GAs)
  - ▶ Simulated Annealing (SA)
  - ▶ Ant Colony Optimization (ACO)
  - ▶ Particle Swam Optimization (PSO)
- 3. Fuzzy Logic**
  - ▶ Fuzzy Set, Fuzz Logic, Fuzzy Algebra
  - ▶ Fuzzy Reasoning and Fuzzy Classification
- 4. Artificial Neural Networks (ANNs)**
  - ▶ Different ANNs
  - ▶ Learning with ANNs
- 5. Advanced Topics**
  - ▶ Mixed(Hybrid) Soft Computing
  - ▶ FL-GA, FL-ANN, GA-ANN, FL-GA-ANN
  - ▶ Hidden Markov Modeling (HMM)
  - ▶ Support Vector Machine (SVM)

# Reference I

## Books:

1. Evolutionary Computing : A Unified Approach  
K. A. De Jong (Prentice Hall Inc, USA) 2009
2. Evolutionary Algorithm for Solving Multi-objective Optimization Problems (2<sup>nd</sup> Edition)  
Collelo, Lament, Veldhnizer ( Spring, 2010)
3. An Introduction to Genetic Algorithm  
Melanic Mitchell (MITPress, 2000)
4. Fuzzy Logic : A Practical Approach  
F. Martin, Mc Neill and Ellen Thro (A P Professional, 2000)
5. Fuzzy Logic with Engineering Applications  
Timothy J. Ross (Wiley, 2015)

## Reference II

6. Foundation of Neural Network, Fuzzy Systems & Knowledge Engineering by Nikole K Kashov (MIT Press, 1998)
7. Neural Networks and Learning Machines  
Simon Haykin (PHI, 2006)
8. Neural Network, Fuzzy Logic and Genetic Algorithm :  
Synthesis and Applications  
S. Rajasekaran and G. A. Vijayalakshmi Pai (Prentice Hall  
India, 2010)
9. Soft Computing : Fundamentals and Applications (2nd Ed.)  
D. K. Pratihari (Narosa, 2013)

For lecture slides and other supporting materials, please visit the course web page at

" <https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html> "

# Evaluation Plan

## 1. Mid-Semester Test : 30%

Syllabus: Fuzzy Logic and Artificial Neural Network

## 2. End-Semester Test : 40%

Syllabus: 20% from the syllabus covered till Mid-semester.  
80% from the syllabus covered post Mid-semester.

## 3. Other Assessment : 30%

- ▶ Class Test 1 : 05% (Topic: Fuzzy Logic)
- ▶ Class Test 2 : 05% (Topic: Artificial Neural Network )
- ▶ Class Test 3 : 05% (Topic: Evolutionary Computing Techniques)  
(Note: Best two out of three tests will be considered.)
- ▶ Practical problem solving: 10% (Topic: Covering three major topics)
- ▶ Attendance : 10% if more than 75% attendance  
-5% if more than 70% and less than 75%  
-10% if more than 60% and less than 50%  
-15% if less than 50%

# Course Website

<https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html>

Email : dsamanta@cse.iitkgp.ac.in

Please use the subject line as: **CS 60108: Spring 2023-2024**

## Teaching Assistants:

1. Mr. Santhoshkumar Peddi, Research Scholar  
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2. Mr. Soham Bandyopadhyay, Research Scholar  
sohamban@kgpian.iitkgp.ac.in

# Today's Topics

## Introduction to Soft Computing

- ▶ Concept of computing
- ▶ Important characteristics of "Computing"
- ▶ "**Soft**" computing vs. "**Hard**" computing
- ▶ Few examples of Soft computing applications
- ▶ Characteristics of Soft computing
- ▶ Hybrid computing



# Concept of Computing

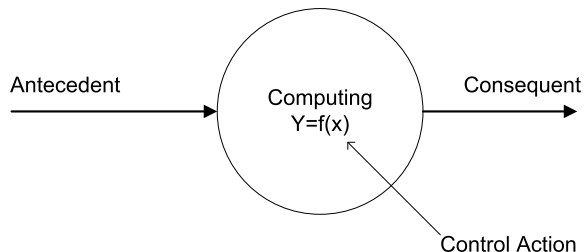


Figure: Basic of computing

$y = f(x)$ ,  $f$  is a mapping function

$f$  is also called a formal method or an algorithm to solve a problem.

# Important Characteristics

1. Should provide precise solution.
2. Control action should be unambiguous and accurate.
3. Suitable for problem, which is easy to model mathematically.

# Hard Computing

In 1996, LA Zade (LAZ) introduced the term hard computing.

According to LAZ: We term a computing as "Hard" computing, if

- ▶ **Precise result is guaranteed**
- ▶ **Control action is unambiguous**
- ▶ **Control action is formally defined (i.e. with mathematical model)**

Example:

- ▶ Solving numerical problems (e.g. Roots of polynomials, Integration etc.)
- ▶ Searching and sorting techniques
- ▶ Solving "Computational Geometry" problems (e.g. Shortest tour in Graph theory, Finding closest pair of points, etc.)

# Problems in some other areas of applications

- ▶ Medical diagnosis
- ▶ Person identification / Computer vision
- ▶ Hand written character recognition
- ▶ Pattern recognition and Machine Intelligence (MI)
- ▶ Weather forecasting
- ▶ VLSI design
- ▶ Network optimization

# Characteristics of Soft Computing

- ▶ It does not require any mathematical modeling of problem solving
- ▶ It may not yield the precise solution
- ▶ Algorithms are adaptive (i.e. it can adjust to the change of dynamic environment)
- ▶ Use some biological inspired methodologies such as genetics, evolution, Ant's behaviors, particles swarming, human nervous systems etc.

# Hybrid Computing

It is a combination of the conventional hard computing and emerging soft computing

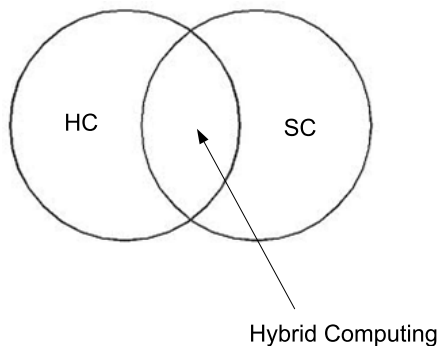


Figure: Concept of Hybrid Computing

# Problems to ponder

- ▶ Hard computing (HC) vs. Soft computing (SC)
- ▶ Limitation(s) in HC and SC
- ▶ Examples of (**only**) Hard computing and (**only**) Soft computing
- ▶ Examples of Hybrid computing

**Any Questions??**