

Soft Computing Applications

Dr. Debasis Samanta

04 January, 2016

Class Organization

Semester : Spring, Session 2015-2016

Course : **Soft Computing Applications**

Code : IT60108

Credit : 4-0-0 = 4

Slot : **C**

Timing : Tuesday 06:00 PM - 08:00 PM

: Friday 06:00 PM - 08:00 PM

Class Room : *SIT Seminar Room*

Course Plan

1. **Introduction to Soft Computing**
2. **Evolutionary Computing**
 - ▶ Genetic Algorithms (GAs)
 - ▶ Simulated Annealing (SA)
 - ▶ Ant Colony Optimization (ACO)
 - ▶ Particle Swarm 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 (2nd 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. Pratihar (Narosa, 2013)

For lecture slides and other supporting materials, please visit the course web page at "www.nid.iitkgp.ernet.in/DSamanta/"

Evaluation Plan

1. Mid-Semester Test : 30%

Syllabus: Fuzzy Logic and Artificial Neural Network

2. End-Semester Test : 50%

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

3. Teacher's Assessment : 20%

- ▶ Class Test 1 : 05% (Topic: Fuzzy Logic)
- ▶ Class Test 2 : 05% (Topic: Artificial Neural Network)
- ▶ Class Test 3 : 05% (Topic: Evolutionary Computing Techniques)
- ▶ Practical problem solving: 05% (Topic: Advanced Topics)

Announcement: One week notice period. Please keep on watching the **Noticeboard**** of the course web page.**

Course Website

www.nid.iitkgp.ernet.in/DSamanta/

Email : debasis.samanta.iitkgp@gmail.com

Please use the subject line as: **IT60108: Spring 2015-2016**

Teaching Assistants:

1. Mr. Gaurang Panchal, Research Scholar
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2. Major Atul Nayyar
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3. Major Priyotosh M.
Will be announced later

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

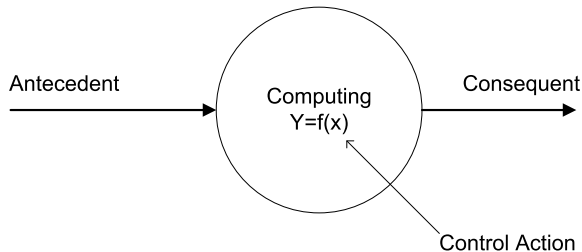


Figure : Basic of computing

$y = f(x)$, 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

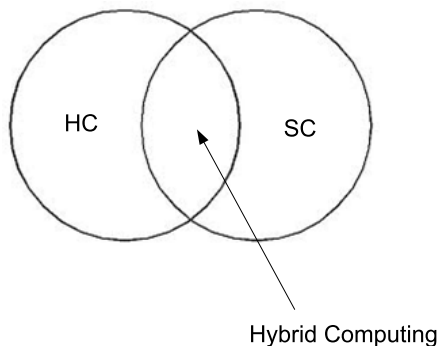


Figure : Concept of Hybrid Computing

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??