

Program: B.Tech. Specialization

Course Code: CSDA4073

Course Name: Soft Computing

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Soft Computing

Syllabus

Unit I: Introduction of Soft Computing

Unit II: Neural Network

Unit III: Fuzzy sets

Unit IV: Evolutionary & stochastic techniques

Unit V: Hybrid systems

Unit VI: Implementation of Recent Techniques



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Soft Computing

Recommended Books

- **Text books** Fuzzy sets and fuzzy logic by George Klir, Bo Yuan, PHI.
- **Reference Book** Neural Networks, S. Haykin, Pearson Education 2ed, 2001
- **Additional online materials**



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The logo of Galgotias University is a stylized 'G' composed of three curved, overlapping bands in shades of yellow, blue, and red. It is centered in the background of the slide.

UNIT I

Introduction of Soft Computing

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INTRODUCTION TO SOFT COMPUTING

- **Concept of computation**
- **Hard computing**
- **Soft computing**
- **How soft computing?**
- **Hard computing vs. Soft computing**
- **Hybrid computing**

CONCEPT OF COMPUTATION

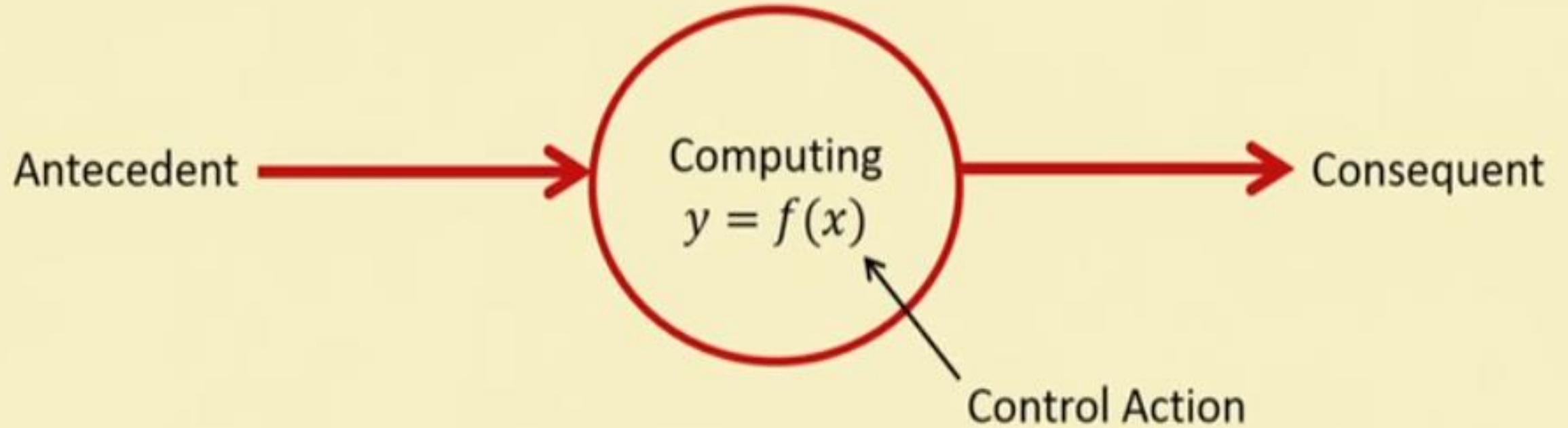


Figure: Basic of computing

Important characteristics of computing

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

Hard computing

- In 1996, **L. A. 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 or algorithm).

Examples of hard computing

- Solving **numerical problems** (e.g., roots of polynomials, integration, etc.).
- **Searching and sorting** techniques.
- Solving **computational geometry** problems (e.g., shortest tour in a graph, finding closet pair of points given a set of points, etc.).

Soft computing

- The term soft computing was proposed by the inventor of fuzzy logic, Lotfi A. Zadeh. He describes it as follows.

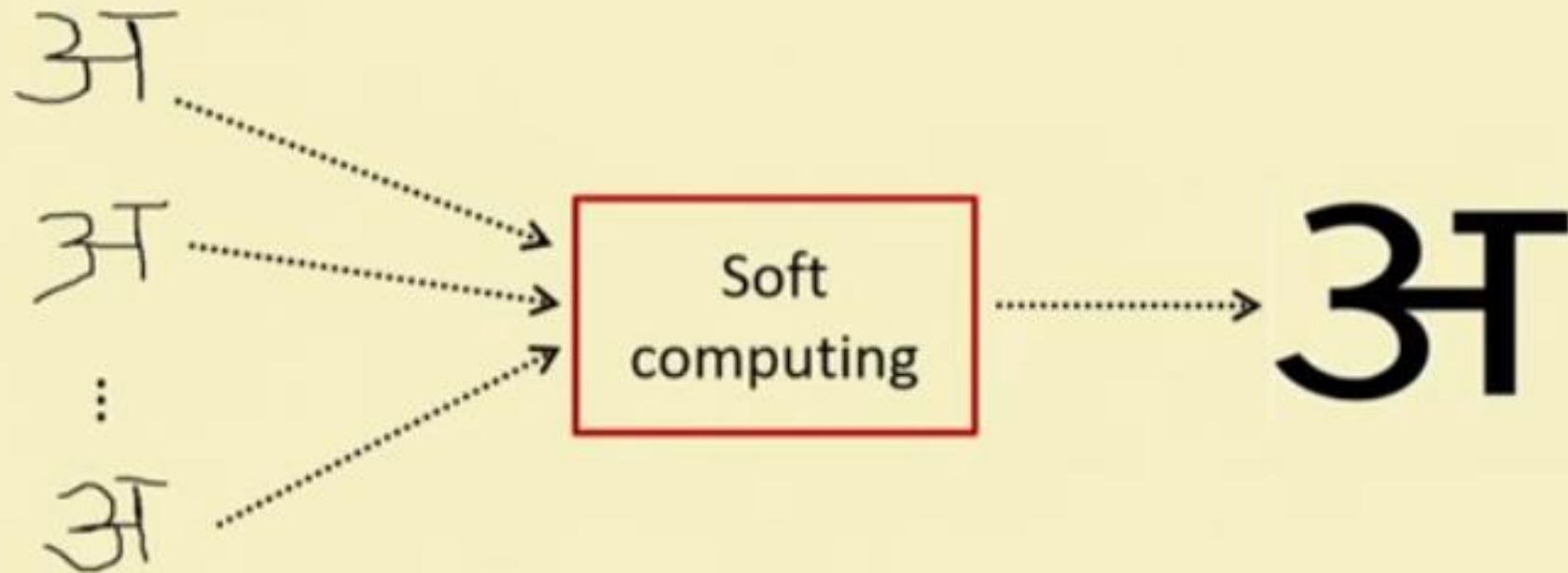
Definition 1: Soft computing

Soft computing is a collection of methodologies that aim to exploit the tolerance for imprecision and uncertainty to achieve tractability, robustness, and low solution cost. Its principal constituents are fuzzy logic, neuro-computing, and probabilistic reasoning. The role model for soft computing is the human mind.

Characteristics of soft computing

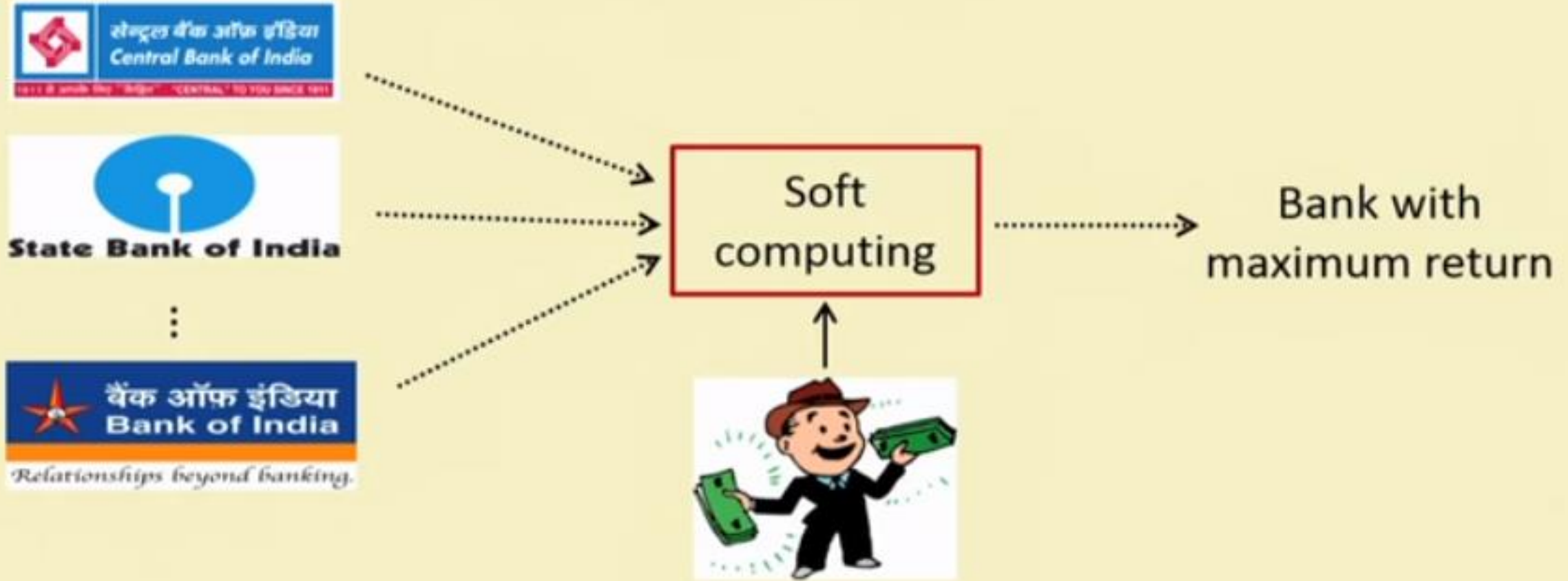
- It **does not require** any mathematical modeling of problem solving.
- It **may not yield** the precise solution.
- Algorithms are **adaptive** (i.e., it can adjust to the change of dynamic environment).

Examples of soft computing



Example: Hand written character recognition
(Artificial Neural Networks)

Examples of soft computing



Example: Money allocation problem

How soft computing?

- How a **student** learns from his **teacher**?
 - Teacher asks questions and tell the answers then.
 - Teacher puts questions and hints answers and asks whether the answers are correct or not.
 - Student thus learn a topic and store in his memory.
 - Based on the knowledge he solves new problems.
- This is the way how human brain works.

How soft computing?

- How **world** selects the best?
 - It starts with a population (random).
 - Reproduces another population (next generation).
 - Rank the population and selects the superior individuals.
- **Genetic algorithm** is based on this natural phenomena.
 - Population is synonymous to solutions.
 - Selection of superior solution is synonymous to exploring the optimal solution.

How soft computing?

- How a **doctor** treats his **patient**?
 - Doctor asks the patient about suffering.
 - Doctor find the symptoms of diseases.
 - Doctor prescribed tests and medicines.
- This is exactly the way **Fuzzy Logic** works.
 - Symptoms are correlated with diseases with uncertainty .

Hard computing vs. Soft computing

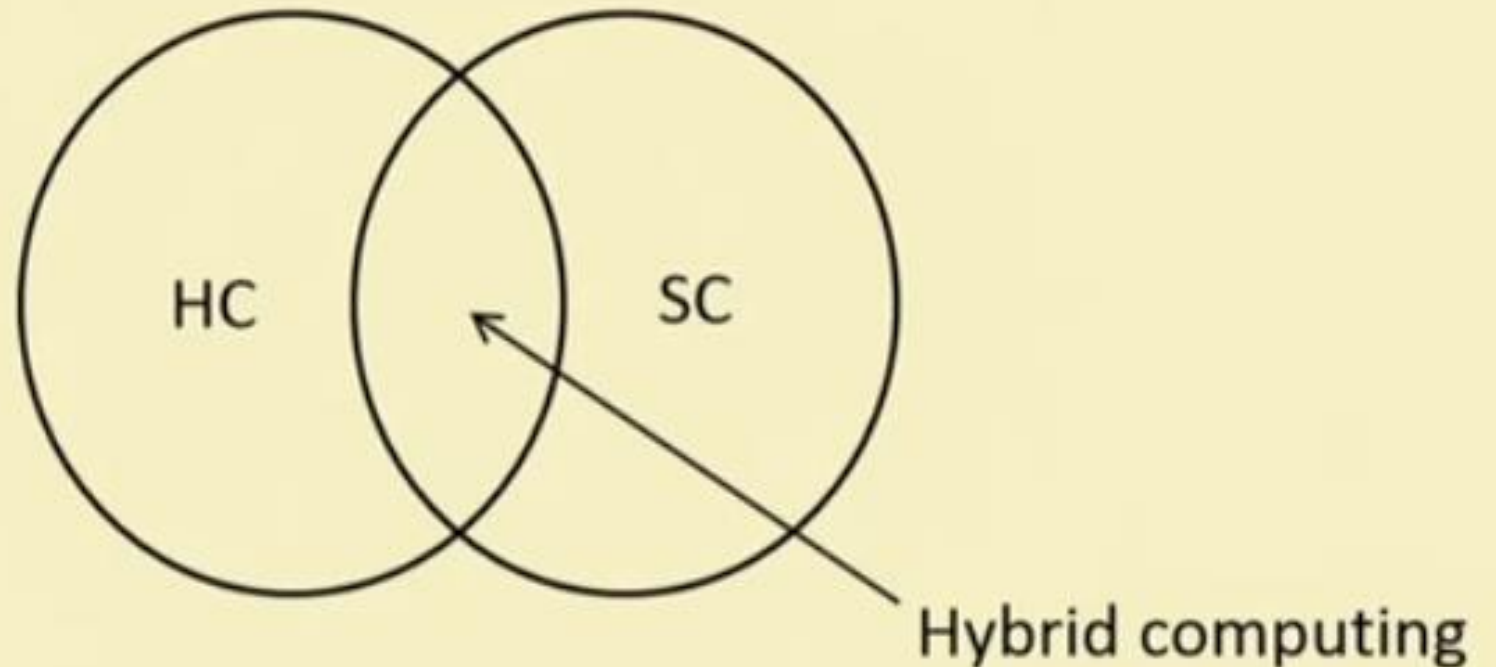
Hard computing	Soft computing
<ul style="list-style-type: none">▪ It requires a precisely stated analytical model and often a lot of computation time.	<ul style="list-style-type: none">▪ It is tolerant of imprecision, uncertainty, partial truth, and approximation.
<ul style="list-style-type: none">▪ It is based on binary logic, crisp systems, numerical analysis and crisp software.	<ul style="list-style-type: none">▪ It is based on fuzzy logic, neural nets and probabilistic reasoning.
<ul style="list-style-type: none">▪ It has the characteristics of precision and categoricity.	<ul style="list-style-type: none">▪ It has the characteristics of approximation and dispositionality.

Hard computing vs. Soft computing

Hard computing	Soft computing
<ul style="list-style-type: none">▪ It is deterministic.	<ul style="list-style-type: none">▪ It incorporates stochasticity.
<ul style="list-style-type: none">▪ It requires exact input data.	<ul style="list-style-type: none">▪ It can deal with ambiguous and noisy data.
<ul style="list-style-type: none">▪ It is strictly sequential.	<ul style="list-style-type: none">▪ It allows parallel computations.
<ul style="list-style-type: none">▪ It produces precise answers.	<ul style="list-style-type: none">▪ It can yield approximate answers

Hybrid computing

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



- You will be able to learn
 - Basic concepts of Fuzzy algebra and then how to solve problems using Fuzzy logic.
 - The framework of Genetic algorithm and solving varieties of optimization problems.
 - How to build an artificial neural network and train it with input data to solve a number of problems, which are not possible to solve with hard

Reference:

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Thank You