Soft Compputing

Unit-1

INTRODUCTION TO SOFT COMPUTING

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

CONCEPT OF COMPUTATION

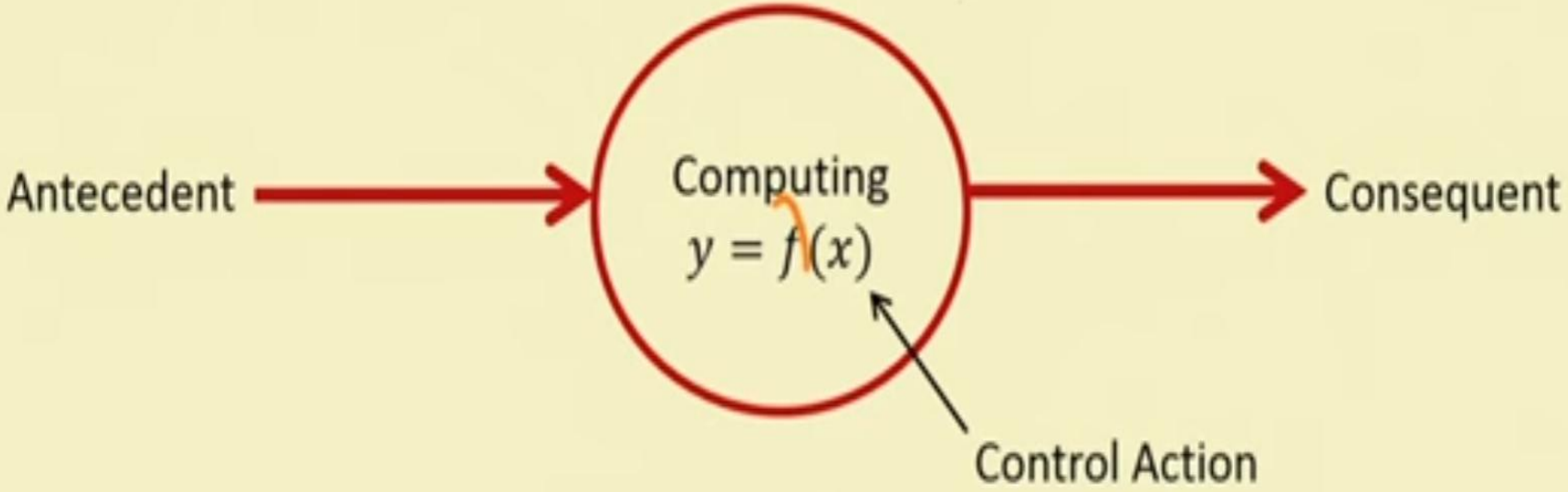


Figure: Basic of computing

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

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

Important characteristics of computing

- Should provide precise solution.
- Control action should ne 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.).
- many more...

Soft computing

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

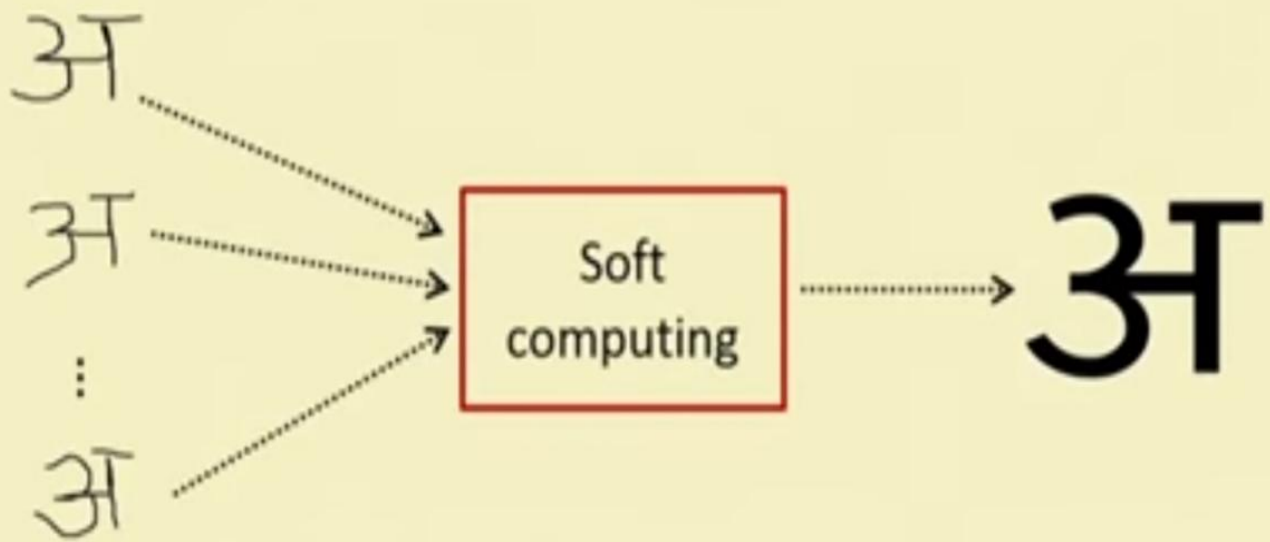
Definition 1: Soft computing

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

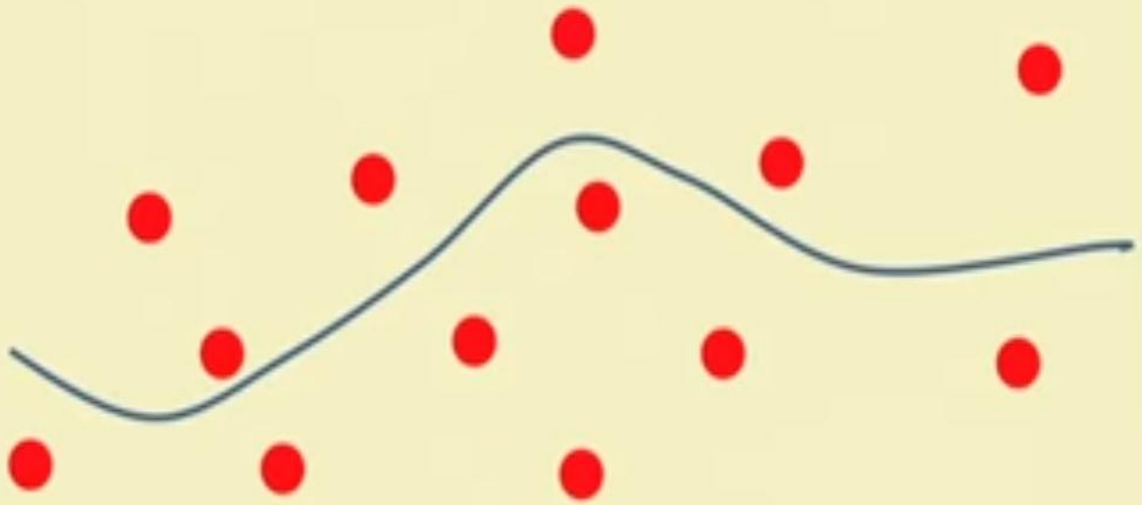
- It does not require any mathematical modeling of problem solving.
- It may not yield the precise solution.
- Algorithms are adaptive (i.e., it can adjust to the change of dynamic environment).
- Use some biological inspired methodologies such as genetics, evolution, Ant's behaviors, particles swarming,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

Examples of soft computing



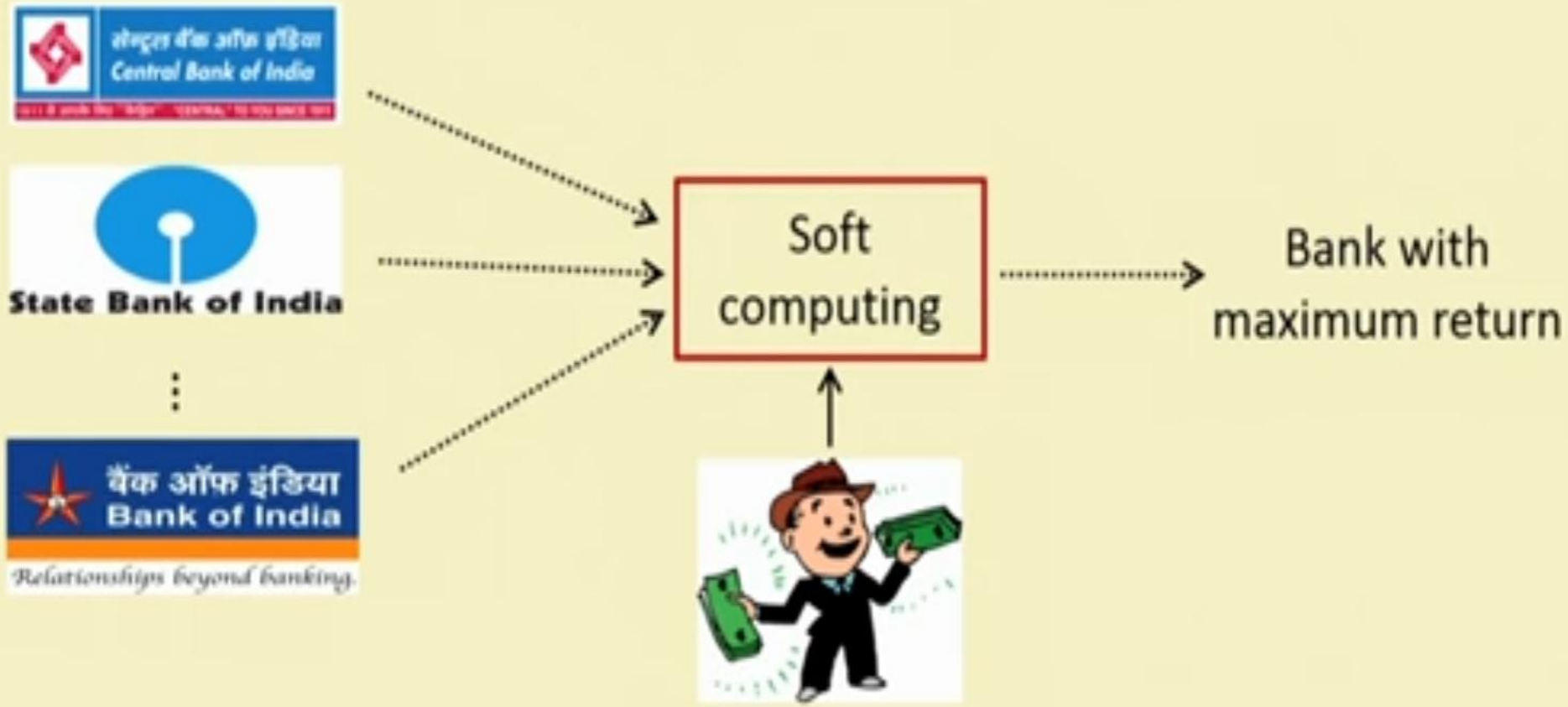
Example: Hand written character recognition
(Artificial Neural Networks)

Examples of soft computing



Example: Robot movement
(Fuzzy Logic)

Examples of soft computing



Example: Money allocation problem
(Evolutionary Computing)

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.
- Based on this concept Artificial Neural Network is used to solve problems.

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 .
  - Doctor prescribes tests/medicines fuzzily.

Hard computing vs. Soft computing

Hard computing	Soft computing
▪ It requires a precisely stated analytical model and often a lot of computation time.	▪ It is tolerant of imprecision, uncertainty, partial truth, and approximation.
▪ It is based on binary logic, crisp systems, numerical analysis and crisp software.	▪ It is based on fuzzy logic, neural nets and probabilistic reasoning.
▪ It has the characteristics of precision and categoricity.	▪ It has the characteristics of approximation and dispositionality.

Hard computing vs. Soft computing

Hard computing	Soft computing
▪ It is deterministic.	▪ It incorporates stochasticity.
▪ It requires exact input data.	▪ It can deal with ambiguous and noisy data.
▪ It is strictly sequential.	▪ It allows parallel computations.
▪ It produces precise answers.	▪ It can yield approximate answers

Hybrid computing

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

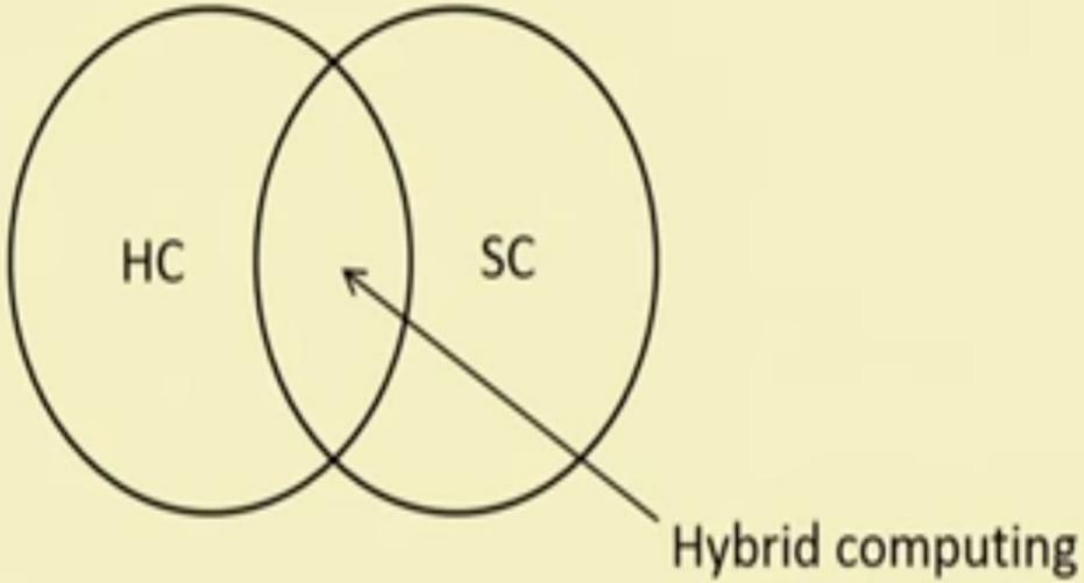


Figure: Concept of Hybrid Computing

THANKS