

# INTRODUCTION TO SOFT COMPUTING

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

## CONCEPT OF COMPUTATION

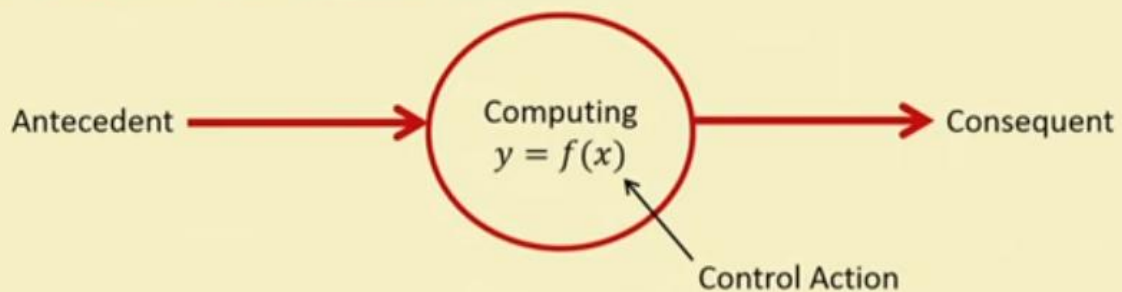


Figure: Basic of computing

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

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

## Hard computing

- **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.).

## Need of soft computing

Sometimes, conventional computing or analytical models does not provide a solution to some real-world problems. In that case, we require other technique like soft computing to obtain an approximate solution.

- Hard computing is used for solving mathematical problems that need a precise answer. It fails to provide solutions for some real-life problems. Thereby for real-life problems whose precise solution does not exist, soft computing helps.
- When conventional mathematical and analytical models fail, soft computing helps, e.g., you can map even the human mind using soft computing.
- Analytical models can be used for solving mathematical problems and valid for ideal cases. But the real-world problems do not have an ideal case; these exist in a non-ideal environment.
- Soft computing is not only limited to theory; it also gives insights into real-life problems.

## What is soft computing

Soft computing is the reverse of hard (conventional) computing. It refers to a group of computational techniques that are based on [artificial intelligence \(AI\)](#) and natural selection. It provides cost-effective solutions to the complex real-life problems for which hard computing solution does not exist.

**Zadeh** coined the term of soft computing in 1992. The objective of soft computing is to provide precise approximation and quick solutions for complex real-life problems.

| S.NO. | Soft Computing  | Hard Computing   |
|-------|---|--|
| 1.    | Soft Computing is liberal of inexactness, uncertainty, partial truth and approximation. | Hard computing needs an exactly stated analytic model.                       |
| 2.    | Soft Computing relies on formal logic and probabilistic reasoning.                      | Hard computing relies on binary logic and crisp system.                      |
| 3.    | Soft computing has the features of approximation.                                       | Hard computing has the features of exactitude (precision).                   |
| 4.    | Soft computing works on ambiguous and noisy data.                                       | Hard computing works on exact data.  |
| 5.    | Soft computing can perform parallel computations.                                       | Hard computing performs sequential computations.                             |
| 7.    | Soft computing produces approximate results.  | Hard computing produces precise results.                                     |
| 8.    | Soft computing can emerge its own programs.   | Hard computing requires programs to be written.                              |
| 9.    | Soft computing uses multi valued logic.<br>Example. <b>Fuzzy Logic</b>                  | Hard computing uses two-valued logic. Example. <b>Binary Logic</b> ( 0 or 1) |

## 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.).

## Soft Computing Techniques:

- 1. Neural Networks (ANN)**
- 2. Fuzzy Logic**
- 3. Genetic Algorithms**