Soft Computing Involves:
1. Computation
2. Hard Computing
2. Soft Computing

1. Computation

CONCEPT OF COMPUTATION

Antecedent ⟶ Computing $y = f(x)$ ⟶ Consequent

Control Action

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.
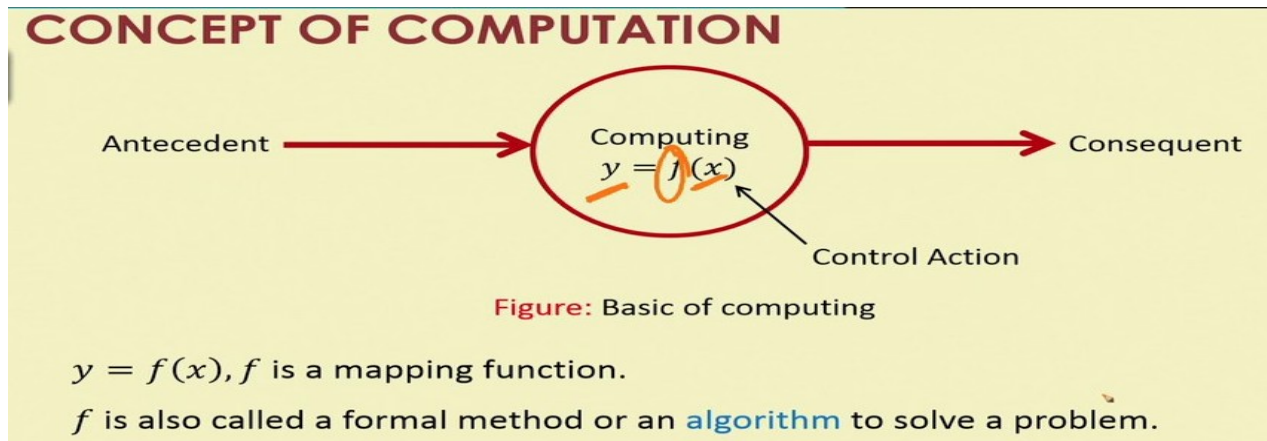
In the context of computing, so the input is called the antecedent and then output is called the consequence and then computing is basically mapping. f is the function basically which is responsible to convert x the input and to some output. So, this is the concept of computing is basically.

Important characteristics of computing

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

2. Hard Computing

Hard computing provides precise result and the step that is required to solve the problem is unambiguous and then the control action; that means, those are the steps that is require is formally defined by means of some mathematical formula or some algorithm.

✓ **Precise result** is guaranteed.

✓ Control action is unambiguous.

✓ Control action is formally defined (i.e., with mathematical model or algorithm).

Examples:

i. To solve numerical problems for example, finding root of polynomials or finding an integration or derivation we usually follow some mathematical models and therefore, it is an example of hard computing.

ii. Searching and Sorting techniques are frequently used in many softwares. So, these are the basically followed by some unambiguous steps and it always gives the precise result and it is basically defined correctly by means of an algorithm. So, it is an example of hard computing.

iii. Solving computational geometry problems (e.g. shortest tour in a graph, etc)

3. Soft Computing

Soft computing is the use of approximate calculations to provide imprecise but usable solutions to complex computational problems. It is an emerging approach to computing, has the ability of the human mind to learn in an environment of uncertainty and imprecision.

The soft computing concept follow three computing paradigms. These are called fuzzy logic, neural computing and probabilistic reasoning.

i. Soft computing is one concept of computing which does not require any mathematical model.

ii. It does not necessary that an algorithm should be followed or the problem that we have to solve should be expressed in terms of mathematical formulation.

iii. Algorithms are adaptive; that means, it can adjust to the change of any dynamical situation.

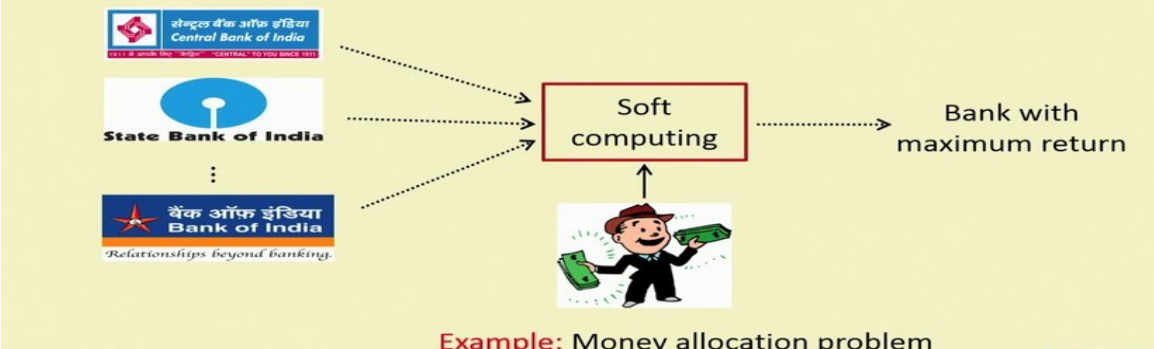iv. Human mind is the role model behind the soft computing and actually it is some biological inspired methodology.

1.

Examples of soft computing
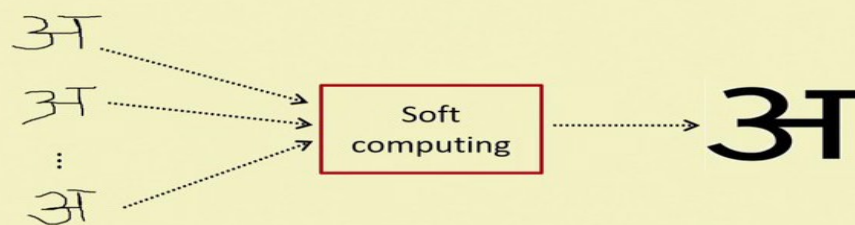
Example: Hand written character recognition (Artificial Neural Networks)

Different people can give the same characters in a different form. Basically we learn by the process that this is the letter resemble to a particular alphabets. So, it is in the same way we learn it and this learned somehow stored in our memory and this is the learning phase and these learning basically works for us to recognize any unseen characters or unseen letters.
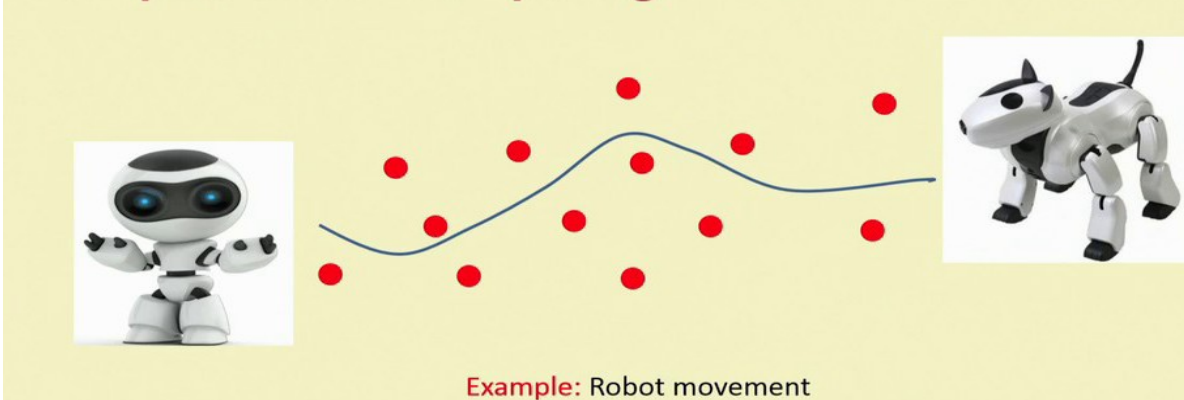
2.

Example: Money allocation problem

This concept is basically can be followed using some probabilistic reasoning or it is called the evolutionary computing for example, genetic algorithm can be followed to solve these kind of problem.

3.

Example: Robot movement

How the robots cacalculate his movement so that without any collision, with any objects, he can move from his current location to target location within a shortest time. This kind of problem, in fact, has lot of uncertainty or impreciseness, defining so for the input is concern and then that kind of uncertainty can be solved using the concept called the fuzzy logic.

How Soft Computing Works?

Example 1:

Consider a Student-Teacher Process. How a student learns from a teacher?

I. Usually teacher ask questions and tell the answer.
ii. Then there is another way teacher puts some questions and hints an answers and ask whether the answers are correct or not, students here basically to check whether the answer correct or not.
iii. Students then, students thus learn a topic and store in his memory.

So, basically by the process if we discuss several time the same different questions, different answers, different questions, hints to the different answer for the same question or different answers for the different questions.

So, students listen to those and then by the process learn a topic and whatever the students learns it basically store in his memory. Now, based on the knowledge he then can solve many new problems assigned to him. So, basically it is a concept of learning how to learn something and then based on this learning how he can solve the problem.

So, this is the way exactly our human brain works in fact. And based on this concept the **artificial neural network** is used for example, hand written character can be recognized.

Example 2: How a doctor treats his patient

Doctor asks the patient about the problem that he is suffering and doctor find the symptoms of disease from the patients input, and then doctor prescribe some tests and medicine.

Here symptoms are correlated with disease and you know whatever the disease doctor will guess or patient will tell they are basically not a certain; there are some uncertainty with the input. This is the exactly the way the fuzzy logic works.

Hard Computing vs Soft Computing

SOFT COMPUTING	Hard computing
Soft Computing is liberal of inexactness, uncertainty, partial truth and approximation.	Hard computing needs exactly state analytic model.
Soft Computing relies on formal logic and probabilistic reasoning.	Hard computing relies on binary logic and crisp system.
Soft computing has the features of approximation and dispositionality.	Hard computing has the features of exactitude(precision) and categoricity.
Soft computing works on ambiguous and noisy data.	Hard computing works on exact data.
Soft computing can perform parallel computations.	Hard computing performs sequential computations.
Soft computing produces approximate results.	Hard computing produces precise results.