

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.



In simple terms, you can understand soft computing - an emerging approach that gives the amazing ability of the human mind. It can map a human mind and the human mind is a role model for soft computing.

Note: Basically, soft computing is different from traditional/conventional computing and it deals with approximation models.

Some characteristics of Soft computing

- Soft computing provides an approximate but imprecise solution for real-life problems.
- The algorithms of soft computing are adaptive, so the current process is not affected by any kind of change in the environment.
- The concept of soft computing is based on **learning from experimental data**. It means that soft computing does not require any mathematical model to solve the problem.
- Soft computing helps users to solve real-world problems by providing approximate results that conventional and analytical models cannot solve.
- It is based on Fuzzy logic, genetic algorithms, machine learning, ANN, and expert systems.

Example

Soft computing deals with the approximation model. you will understand with the help of examples of how it deals with the approximation model.

Let's consider a problem that actually does not have any solution via traditional computing, but soft computing gives the approximate solution.

string1 = "xyz" and string2 = "xyw"

1. Problem 1
2. Are string1 and string2 same?
3. Solution
4. No, the solution is simply No. It does not require any algorithm to analyze this.

Let's modify the problem a bit.

1. Problem 2
2. How much string1 and string2 are same?
3. Solution
4. Through conventional programming, either the answer is Yes or No. But these strings might be 80% similar according to soft computing.

You have noticed that soft computing gave us the approximate solution.

Applications of soft computing

There are several applications of soft computing where it is used. Some of them are listed below:

- It is widely used in **gaming products like Poker and Checker**.
- In kitchen appliances, such as **Microwave and Rice cooker**.
- In most used home appliances - **Washing Machine, Heater, Refrigerator, and AC** as well.
- Apart from all these usages, it is also used in **Robotics work** (Emotional per Robot form).
- **Image processing and Data compression** are also popular applications of soft computing.
- Used for handwriting recognition.

As we already said that, soft computing provides the solution to real-time problems and here you can see that. Besides these applications, there are many other applications of soft computing.

Need of soft computing

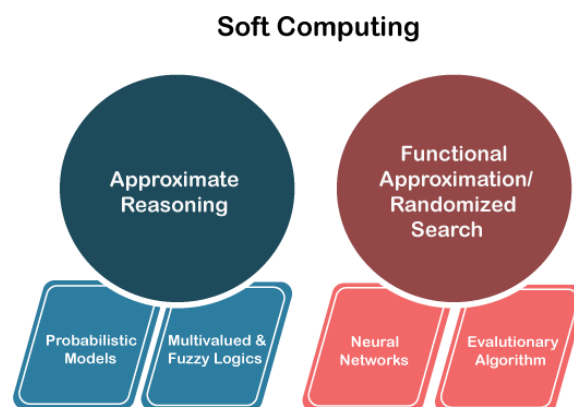
Sometimes, conventional computing or analytical models does not provide a solution to some real-world problems. In that case, we require other technique like soft computing to obtain an approximate solution.

- 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.
- Like all the above reasons, Soft computing helps to map the human mind, which cannot be possible with conventional mathematical and analytical models.

Elements of soft computing

Soft computing is viewed as a foundation component for an emerging field of conceptual intelligence. Fuzzy Logic (FL), Machine Learning (ML), Neural Network (NN), Probabilistic Reasoning (PR), and Evolutionary Computation (EC) are the supplements of soft computing. Also, these are techniques used by soft computing to resolve any complex problem.



Any problems can be resolved effectively using these components. Following are three types of techniques used by soft computing:

- Fuzzy Logic
- Artificial Neural Network (ANN)
- Genetic Algorithms

Fuzzy Logic (FL)

Fuzzy logic is nothing but mathematical logic which tries to solve problems with an open and imprecise spectrum of data. It makes it easy to obtain an array of precise conclusions.

Fuzzy logic is basically designed to achieve the best possible solution to complex problems from all the available information and input data. Fuzzy logics are considered as the best solution finders.

Neural Network (ANN)

Neural networks were developed in the 1950s, which helped soft computing to solve real-world problems, which a computer cannot do itself. We all know that a human brain can easily describe real-world conditions, but a computer cannot.

An artificial neural network (ANN) emulates a network of neurons that makes a human brain (means a machine that can think like a human mind). Thereby the computer or a machine can learn things so that they can take decisions like the human brain.

Artificial Neural Networks (ANN) are mutually connected with brain cells and created using regular computing programming. It is like as the human neural system.

Genetic Algorithms (GA)

Genetic algorithm is almost based on nature and take all inspirations from it. There is no genetic algorithm that is based on search-based algorithms, which find its roots in natural selection and the concept of genetics.

In addition, a genetic algorithm is a subset of a large branch of computation.

Soft computing vs hard computing

Parameters	Soft Computing	Hard Computing
Computation time	Takes less computation time.	Takes more computation time.
Dependency	It depends on approximation and dispositional.	It is mainly based on binary logic and numerical systems.
Computation type	Parallel computation	Sequential computation
Result/Output	Approximate result	Exact and precise result
Example	Neural Networks, such as Madaline, Adaline, Art Networks.	Any numerical problem or traditional methods of solving using personal computers.

Hard computing uses existing mathematical algorithms to solve certain problems. It provides a precise and exact solution of the problem. Any numerical problem is an example of hard computing.

On the other hand, soft computing is a different approach than hard computing. In soft computing, we compute solutions to the existing complex problems. The result calculated or provided by soft computing are also not precise. They are imprecise and fuzzy in nature.

