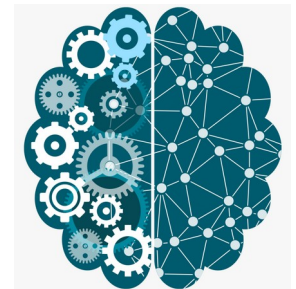


Soft Computing: Requirements, Characteristics and Applications

Tushar B. Kute,
<http://tusharkute.com>



Need of Soft Computing

- Many analytical models are valid for ideal cases. Real-world problems exist in a non-ideal environment.
- Soft computing provides insights into real-world problems and is just not limited to theory.
- Hard computing is best suited for solving mathematical problems which give some precise answers.
- Some important fields like Biology, Medicine and humanities, etc are still intractable using Conventional mathematical and Analytical models.
- It is possible to map the human mind with the help of Soft computing but it is not possible with Conventional mathematical and Analytical models.

Need of Soft Computing

- Examples –
- Consider a problem where a string w_1 is “abc” and string w_2 is “abd”.
Problem-1 :
Tell that whether w_1 is the same as w_2 or not?
Solution –
The answer is simply No, it means there is an algorithm by which we can analyze it.
- Problem-2 :
Tell how much these two strings are similar?
Solution –
The answer from conventional computing is either YES or NO. But these maybe 80% similar, this can be answered only by Soft Computing.

Soft Computing: Recent Developments

- In the field of Big Data, soft computing working for data analyzing models, data behavior models, data decision, etc.
- In case of Recommender system, soft computing plays an important role for analyzing the problem on the based of algorithm and works for precise results.
- In Behavior and decision science, soft computing used in this for analyzing the behavior, and model of soft computing works accordingly.
- In the fields of Mechanical Engineering, soft computing is a role model for computing problems such that how a machine will works and how it will make the decision for a specific problem or input given.
- In this field of Computer Engineering, you can say it is core part of soft computing and computing working on advanced level like Machine learning, Artificial intelligence, etc.

Soft Computing: Characteristics

- Human expertise
 - Soft computing utilizes human expertise in the form of fuzzy if-then rules, as well as in conventional knowledge representations, to solve practical problems.
- Biologically inspired computing models
 - Inspired by biological neural networks, artificial neural networks are employed extensively in soft computing to deal with perception, pattern recognition, and nonlinear regression and classification problems.

Soft Computing: Characteristics

- New optimization techniques
 - Soft computing applies innovative optimization methods arising from various sources, they are genetic algorithms (inspired by the evolution and selection process), simulated annealing (motivated by thermodynamics), the random search method, and the downhill Simplex method.
 - These optimization methods do not require the gradient vector of an objective function, so they are more flexible in dealing with complex optimization problems.

Soft Computing: Characteristics

- Numerical computation
 - Unlike symbolic AI, soft computing relies mainly on numerical computation.
 - Incorporation of symbolic techniques in soft computing is an active research area within this field.

Soft Computing: Characteristics

- New application domains
 - Because of its numerical computation, soft computing has found a number of new application domains besides that of AI approaches.
 - These application domains are mostly computation intensive and include adaptive signal processing, adaptive control, nonlinear system identification, nonlinear regression, and pattern recognition.

Soft Computing: Characteristics

- Model-free learning Neural networks and adaptive fuzzy inference systems
 - have the ability to construct models using only target system sample data.
 - Detailed insight into the target system_helps set up the initial model structure, but it is not mandatory.

Soft Computing: Characteristics

- Intensive computation Without assuming too much background
 - knowledge of the problem being solved, neuro-fuzzy and soft computing rely heavily on high-speed number-crunching computation to find rules or regularity in datasets.
 - This is a common feature of all areas of computational intelligence.

Soft Computing: Characteristics

- Fault tolerance Both neural networks and fuzzy inference systems exhibit fault tolerance.
 - The deletion of a neuron in a neural network, or a rule in a fuzzy inference system, does not necessarily destroy the system.
 - Instead, the system continues performing because of its parallel and redundant architecture, although performance quality gradually deteriorates.

Soft Computing: Characteristics

- Goal driven characteristics Neuro-fuzzy and soft computing are goal driven;
 - the path leading from the current state to the solution does not really matter as long as we are moving toward the goal in the long run.
 - This is particularly true when used with derivative-free optimization schemes, such as genetic algorithms, simulated annealing, and the random search method.
 - Domain specific knowledge helps reduces the amount of computation and search time, but it is not a requirement.

Soft Computing: Characteristics

- Real-world applications
 - Most real-world problems are large scale and inevitably incorporate built-in uncertainties; this precludes using conventional approaches that require detailed description of the problem being solved.
 - Soft computing is an integrated approach that can usually utilize specific techniques within subtasks to construct generally satisfactory solutions to real. world problems.

Soft Computing Applications

- Handwritten Script Recognition using Soft Computing
 - Handwritten Script Recognition is one of the demanding parts of computer science. It can translate multilingual documents and sort the various scripts accordingly.
 - It uses the concept of “block-level technique” where the system recognizes the particular script from a number of script documents given.
 - It uses a Discrete Cosine Transform (DCT), and discrete wavelets Transform (DWT) together, which classify the scripts according to their features.

Soft Computing Applications

- Image Processing and Data Compression using Soft Computing
 - Image analysis is one of the most important parts of the medical field. It is a high-level processing technique which includes recognition and bifurcation of patterns.
 - Using soft computing solves the problem of computational complexity and efficiency in the classification. Techniques of soft computing include Genetic Algorithms, Genetic Programming, Classifier Systems, Evolution Strategies, artificial life, and a few others, which are used here.
 - These algorithms give the fastest solutions to pattern recognition. These help in analyzing the medical images obtained from microscopes as well as examine the X-rays.

Soft Computing Applications

- Soft Computing in Automotive Systems and Manufacturing
 - The use of soft computing has solved a major misconception that the automobile industry is slow to adapt. Fuzzy logic is a technique used in vehicles to build classic control methods.
 - It takes the example of human behavior, which is described in the forms of rule – “If-Then “statements.
 - The logic controller then converts the sensor inputs into fuzzy variables that are then defined according to these rules. Fuzzy logic techniques are used in engine control, automatic transmissions, antiskid steering, etc.

Soft Computing Applications

- Soft Computing based Architecture
 - An intelligent building takes inputs from the sensors and controls effectors by using them.
 - The construction industry uses the technique of DAI (Distributed Artificial Intelligence) and fuzzy genetic agents to provide the building with capabilities that match human intelligence.
 - The fuzzy logic is used to create behavior-based architecture in intelligent buildings to deal with the unpredictable nature of the environment, and these agents embed sensory information in the buildings.

Soft Computing Applications

- Soft Computing and Decision Support System
 - Soft computing gives an advantage of reducing the cost of the decision support system. The techniques are used to design, maintain, and maximize the value of the decision process.
 - The first application of fuzzy logic is to create a decision system that can predict any sort of risk.
 - The second application is using fuzzy information that selects the areas which need replacement.

Soft Computing Applications

- Soft Computing Techniques in Power System Analysis
 - Soft computing uses the method of Artificial Neural Network (ANN) to predict any instability in the voltage of the power system.
 - Using the ANN, the pending voltage instability can be predicted. The methods which are deployed here, are very low in cost.

Soft Computing Applications

- Soft Computing Techniques in Bioinformatics
 - The techniques of soft computing help in modifying any uncertainty and indifference that biometrics data may have.
 - Soft computing is a technique that provides distinct low-cost solutions with the help of algorithms, databases, Fuzzy Sets (FSs), and Artificial Neural Networks (ANNs).
 - These techniques are best suited to give quality results in an efficient way.

Soft Computing Applications

- Soft Computing in Investment and Trading
 - The data present in the finance field is in opulence and traditional computing is not able to handle and process that kind of data.
 - There are various approaches done through soft computing techniques that help to handle noisy data.
 - Pattern recognition technique is used to analyze the pattern or behavior of the data and time series is used to predict future trading points.

Soft Computing Applications

- Recent developments in soft computing
 - People have started using techniques of soft computing like fuzzy sets theory, neural nets, fuzzy neuro system, adaptive neuro-fuzzy inference system (ANFIS), for driving various numerical simulation analysis.
 - Soft computing has helped in modeling the processes of machines with the help of artificial intelligence.

Soft Computing Applications

- Also, there are certain areas where soft computing is in budding stages only and is expected to see a massive evolution:
 - Big Data
 - Recommender system
 - Behavior and decision science
 - Mechanical Engineering
 - Computer Engineering
 - Civil Engineering

References:

- <https://wisdomplexus.com>

Thank you

This presentation is created using LibreOffice Impress 7.0.1.2, can be used freely as per GNU General Public License



@mitu_skillologies



/mITuSkillologies



@mitu_group



/company/mitu-
skillologies



MITUSkillologies

Web Resources

<https://mitu.co.in>

<http://tusharkute.com>

contact@mitu.co.in

tushar@tusharkute.com